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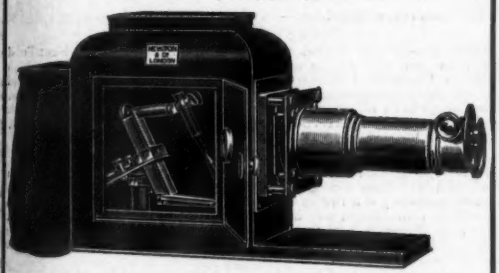

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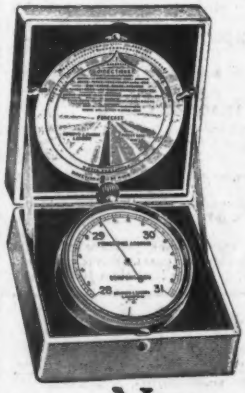

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June 24, 1920.

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Medical Research and the Practitioner.

IN the interim report[1] issued recently by the Consultative Council on Medical and Allied Services, under the chairmanship of Lord Dawson of Penn, the proportion given to research is disappointingly small. Perhaps this was inevitable. The medical organisation suggested includes effective laboratory equipment at every stage from the domiciliary work of the practitioner to the conducting of prolonged researches by the Medical Research Council; but the portions dealing with research proper are very generalised. A document like this should be a new charter for medicine, and the scientific mind naturally expects to see the scientific groundwork fully developed. For increased and accelerated research is essential to the continued expansion of scientific medicine. In the report it is hoped

"that the scheme of services which we suggest would facilitate enquiry into the causes of disease and the possible remedies. The facts which indicated the need for such enquiry might, we think, often be brought together in the first instance by the medical practitioners in a given locality."

It is difficult to justify the hesitating note of these sentences. Medical practice bristles with unsolved problems; but usually the practitioner is inadequately trained to discover them. Sir James Mackenzie shows what a general practitioner can do when he has the interest and the capacity to train himself. The war has unveiled many gaps in scientific medicine. Even the war reports of the Medical Research Council, not to refer to the many others, prove that the science of medicine will not advance merely by a re-shuffling of the medical army, but by greater intensity of research and discovery.

Medicine has to face the fact that, for practical purposes, it knows nothing about the cause of measles, scarlet fever, mumps, influenza, rheumatic fever, cancer, or other forms of malignancy; nor is the knowledge of the causes of dead and premature births more than elementary. These are only a few illustrations taken from the Medical Research Committee's fifth annual report. It is reasonable to expect that, in a scheme that brings the medical profession into a unity, the clotted masses of problems facing the general practitioner and scientific worker alike would be sketched with precision and force. The report does add that

"there are great and important opportunities for research in preventive medicine, which at present are scarcely dealt with by any organisation, and mostly are not attempted by individuals. Encouragement of research in the prevention of disease should, we think, be developed, for the materials are everywhere, and the results would undoubtedly be valuable."

From this the lay public would not readily gather that the future value of the general practitioner to the State depends on the development of research in at least the following sciences: biology, physiology, bio-chemistry, pathology, and experimental therapeutics. To the raw materials of such researches the various classes of medical practitioners can contribute; but they have little stimulus to do so unless they keep more closely in the currents of the scientific work of the schools.

The report indicates that, for the purposes of research into fundamental problems, "the profession would no doubt look to the Universities and the Medical Research Council for guidance and assistance." When we reflect that the medical profession has to deal with sanatoria for tuberculosis, recuperative centres, hospitals for curable or incurable mental disease, institutions for the feeble-minded, epileptic colonies, orthopædic centres, hospitals for infectious diseases, not to mention general hospitals and the innumerable fresh points emerging in every man's practice, there is abundant occasion to look both for "guidance and assistance."

What we miss here is a compact and well-loaded presentment of the case for research from the general practitioner's point of view. At present neither general practitioners nor consultants have an adequate conviction that more and more as time goes on the value of their work will depend on the capacity to understand and to prevent the beginnings of disease, and that, without effective training in research at some stage of their career, they can make little headway in pre-

[1] Ministry of Health Consultative Council on Medical and Allied Services. Interim Report on the Future Provision of Medical and Allied Services. Pp. 28. (London: H.M. Stationery Office, 1920.) Cmd. 693. Price 1s. net.

ventive medicine as now understood. The general practitioner's part in "field" and "team" research might well form the subject of a special reference to the Consultative Council on Medical and Allied Services. If the world of general practice does not realise that research is of vital importance to every branch of medicine, such is certainly not the case with the world of science.

Theory of Dioptric Instruments.

Ferraris' "Dioptric Instruments": Being an Elementary Exposition of Gauss' Theory and its Applications. Translated by Dr. Oscar Faber from Prof. F. Lippich's German translation of Prof. Galileo Ferraris' Italian work entitled "The Fundamental Properties of Dioptric Instruments." Pp. xxxi+214. (London: H.M.S.O., 1919.) Price 4*s.* net.

THE original of this translation was published by Prof. Galileo Ferraris, of Turin, in 1876. As a copy of this original could apparently not be procured, the English translation was made from a German one by Lippich, which appeared in 1879. At the time of its appearance the book unquestionably marked a great advance in the treatment of its subject, and well deserved the extremely favourable review with which Abbe honoured the German translation in the first volume of the *Zeitschrift für Instrumentenkunde*.

Abbe himself, however, has to be credited with far greater advances in the theory of image-formation by optical instruments with which the book before us deals, for his purely geometrical treatment of the problem leads to the same results without being limited to the infinitely constricted "threadlike space around the optical axis" which still plays so large a part in text-books, although, with light of finite wave-length, nothing of any optical interest can possibly happen within it. On the other hand, Abbe was the first to deal systematically with the actual course of light through instruments in accordance with the limitations imposed by restricted apertures and by deliberately placed diaphragms, and inasmuch as the great majority of actual instruments are used only at fixed or nearly fixed conjugate distances, the actual course of the rays so determined is of far greater importance and value, both in the designing of instruments and in the discussion of the effects produced by them, than the rays referred to the Gaussian principle and focal planes and points which form a convenient *pons asinorum* in the general theory of lens systems.

Ferraris' treatment of the Gaussian theory is, however, less open to the objections just alluded to than that adopted in most books, and in dealing with the Galilean telescope he comes remarkably close to the correct treatment of the problem of its field of view, which is so easily obtained now by Abbe's theory of the entrance- and exit-pupil of instruments. Beginners and users of optical instruments desiring to acquire a general knowledge of their elementary theory will also welcome the numerous and frequently elegant graphical solutions of the various problems which are given throughout as alternatives to numerical calculations by algebraical formulæ. The chief and decidedly regrettable omission is that the simple problem of achromatism is not dealt with at all. It is, of course, not a part of the Gaussian theory, and the omission is therefore justifiable; but it is so closely bound up with the proper explanation of the effects produced by compound object-glasses and eyepieces that the book would certainly have gained in value if the subject had been included.

The book is not so free from misprints as one would wish, and there is a really bad muddle on pp. 87–94, where the properties of thick lenses are discussed. This is not a case of a simple misprint or transposition of diagrams, but of actual errors by either the original author or one of the translators. Thus on p. 87 a thick biconvex lens is stated to be convergent if its thickness is less than one-third of the sum of the radii (both taken as positive, with $\mu=1{\cdot}5$). This should be three times instead of one-third. Then, on p. 93 a meniscus with the shorter radius on its concave face is stated to be always convergent; and on p. 94 the meniscus with the shallower curve on the concave face is credited with being divergent, telescopic, or convergent according to thickness. The actual facts are, of course, the other way about. Immediately after this the properties of a concentric lens are correctly stated.

On p. 144 the strange conclusion is reached that of two eyepieces of the same equivalent focal length that one is to be preferred which has the *closer* eye-point. This is directly contrary to the experience of every observer.

In the calculations of the properties of the human eye, or rather of its "simplified model," the author sets a very bad example by starting with data given with three significant figures and undoubtedly uncertain even then in the third figure, and calculating all the deduced figures with six, and even seven, significant figures (pp. 71–75). The idea of beginners that the percentage-accuracy of observed data can be indefinitely increased by putting them through the mathe-

matical mill with an imposing number of figures is sufficiently difficult to eradicate without such examples by teachers!

Apart from a few blemishes of the kind alluded to, the book may still, forty-four years after its first appearance, be recommended as worthy of careful study. A. E. C.

The International Research Council.

International Research Council: Constitutive Assembly held at Brussels, July 18 to July 28, 1919. Reports of Proceedings. Edited by Sir Arthur Schuster. Pp. iii+286. (London: Harrison and Sons, 1920.) Price 10*s.* 6*d.*

THE Constitutive Assembly of the International Research Council, which met at Brussels on July 18, 1919, established for certain subjects new international organisations to replace those existing before the war, and in this volume we have the official text of the statutes there adopted or proposed, as well as the *procès-verbaux* of the different meetings which were held.

It will be remembered that in October, 1918, a conference of the scientific academies of the Allied nations was held in London at the invitation of the Royal Society to consider the action which should be taken in regard to international associations; for some had lapsed during the war, and others were unlikely to meet in their old form for some years to come. The resolutions then agreed to were carried further at a second conference which was held at Paris in November of the same year, when the International Research Council was formed, and an executive committee appointed to prepare proposals to be submitted to the Constitutive Assembly at Brussels. The meeting at Brussels formed the third stage in the formation of the new international organisation which had been decided upon in London, and at it the statutes of the International Research Council and of the Unions for Astronomy, for Geodesy and Geophysics, and for Pure and Applied Chemistry were approved.

The legal domicile of the International Research Council is at Brussels, where the general assembly will meet from time to time; but this in no way restricts the Unions, the members of which determine the places of their bureaux and of their periodical meetings as they please. The countries participating in the foundation of the International Research Council are Belgium, Brazil, the United States, France, the United Kingdom, Australia, Canada, New Zealand, South Africa, Greece, Italy, Japan, Poland, Portugal, Rumania, and Serbia, in addition to which the following neutral countries were invited to join the Council: China, Siam, the Argentine Republic, Chile, Denmark, Spain, Mexico, the Principality of Monaco, Norway, Holland, Sweden, Switzerland, and also Czecho-Slovakia.

Besides the three Unions which were definitely established at the Brussels meeting, proposals were made that several others—mathematics, physics, radiotelegraphy, geology, biology, geography, and bibliography—should be formed, and draft statutes for these were presented in order that the executive committee might communicate them to the National Research Councils of the different countries for the desirability of forming such international unions to be considered. The machinery therefore exists for constituting an international organisation in any branch of science where it will be of service. Several countries have already formally signified their adherence to the International Research Council, and some also to the Unions which have already been formed.

It has been proposed that the draft statutes of the Mathematical Union should be discussed at an international meeting at Strasbourg this autumn, and doubtless representatives of other branches of science will hold similar meetings in due course to consider the desirability of forming unions of their own.

For all such meetings this volume of the proceedings and reports of the Brussels meeting will be of great value, for the general organisation differs from that of earlier associations, and may at first sight seem to be somewhat cumbrous; but a perusal of the documents now published will show that each union can provide itself with the constitution best suited to its own requirements, while conforming at the same time to the essential features of the International Research Council.

Problems of Population.

(1) *Problems of Population and Parenthood. (Being the Second Report of, and the Chief Evidence taken by, the National Birth-rate Commission,* 1918–20.) Pp. clxvi+423. (London: Chapman and Hall, Ltd., 1920.) Price 25*s.* net.

(2) *The Social Diseases: Tuberculosis, Syphilis, Alcoholism, Sterility.* By Dr. J. Héricourt. Translated, and with a final chapter, by Bernard Miall. Pp. x+246. (London: George Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., 1920.) Price 7*s.* 6*d.* net.

(3) *The Venereal Problem.* By E. T. Burke. Pp. 208. (London: Henry Kimpton, 1919.) Price 7*s.* 6*d.* net.

(1) MR. JOSEPH CHAMBERLAIN set a precedent when he gave the name of "Tariff Commission" to a body created by him-

self alone. Previously the word "Commission" had been generally applied only to bodies created by Royal or Parliamentary authority, and having power to call witnesses before them, to whom each member of the Commission could put questions. Where bodies had been created for the purpose of hearing evidence tendered by voluntary witnesses, as had been done with advantage by the Charity Organisation Society, they were usually called "special committees." They are now often called "Commissions" in imitation of Mr. Chamberlain's action, and if it is clearly understood that they have no compulsory powers, there seems no harm in applying that term to them as denoting their method of action rather than the authority under which they act. In one respect they are not unlike many Royal Commissions. They consist largely of people who are known to have formed strong opinions on one side or the other, and accordingly their conclusions, if any sort of unanimity can be arrived at, are often in the nature of a feeble compromise, or, on the other hand, if both parties stand to their guns, are split into majority and minority reports. Even so, such reports may be useful as collections of facts and as presenting to the public materials for forming its own judgment.

The test, therefore, is: Are the results obtained of value? We think the report of the "National Birth-rate Commission," which has been published under the title of "Problems of Population and Parenthood," very fairly answers this test. It shows a continuous reduction in the birth-rate in England and Wales from 24 per thousand of the population in 1913 to 18 per thousand in 1918. For the further elucidation of the problems arising out of this fact, the Commission unanimously passed resolutions in favour of the establishment of a permanent Anthropometric Department under the Ministry of Health, and of a General Register. The practice of restricting the family has begun with educated and professional persons, and is gradually spreading through the whole community. That it should be so seems to be regarded by the majority of the Commissioners as inevitable, but they acknowledge the value of the unrestricted family as a training in self-sacrifice, mutual help, and efficiency, conducing to a better prospect of happiness than the restricted family in general can afford. When the practice of restriction of families is adopted, the tendency is to limit the number to that which will not restore the deficit caused by the loss of the generation that is passing. We thus get a diminishing population, leading to what has been called "race-suicide."

The conditions in which an increase of the population is not desirable do not exist in the British Empire. So far as they exist in Great Britain, emigration (as Sir Rider Haggard suggests) seems to be the right means of meeting them. The Commission reports that there is no moral issue raised in respect of the limitation of the family when there are good reasons for such a course, but that the moral difficulty arises as to the means which may be used for that purpose. Ecclesiastical authorities allow of a limitation of intercourse, which does not afford a complete security, but not of any other method. If, however, the rightfulness of the limitation be admitted, the method by which it is to be effected would seem to be a question of physiology and perhaps of æsthetics rather than one of ethics. Some of the methods suggested are repulsive, and it is to be hoped none of them will become popular.

(2) Dr. Héricourt approaches the subject from a different point of view in dealing with sterility as one of the social diseases of France, where the birth-rate has been steadily falling and depopulation in progress for many years. He attributes this to voluntary restriction, and shows that the richer inhabitants are the less fruitful, and the poorer the more fruitful. He proposes a variety of remedies, ranging from the moral encouragement of large families to the taxation of celibates and of small families. He rejects the expedient of a direct bounty from the State to the parent. He would use all legal means to suppress publications in which the limitation of families is recommended, and to prevent the sale of articles designed to effect that object.

(3) The venereal problem is a subject common to all the three volumes under review, and it is curious to note that it is only recently that it has been possible to discuss it with the freedom that all alike use. This is in some degree due to the war. Since the days when Alva brigaded his "quatre cents courtesanes à cheval, belles et braves comme princesses, et huit cents à pied, bien à point aussi," and long before, indiscriminate sexual indulgence has been one of the incidents of a time of warfare. The risk attaching to it may be mitigated by suitable measures of military discipline, but the effectual application of similar measures to the civil population would be difficult, if possible. The urgency of the problem lies in the possibility of communicating the infection to innocent persons and to unborn children, and in the loss to the community arising from the destruction of life and efficiency caused by the disease. In the face of these evils it is not necessary to discuss the old view that syphilis was a disease the risk of which was voluntarily incurred in the

performance of an immoral act. If prostitution could be abolished, venereal disease would probably in time become extinct, but no means have yet been discovered by which, mankind being what it is, prostitution can be abolished.

All the authors alike urge propaganda. The National Birth-rate Commission thinks that the Ministry of Health should direct the attention of the public to the urgent duties of citizens in the matter. Dr. Héricourt says that we must act upon the will of the individual by persuasion through fear and through interest, and mentions a work by Prof. Fournier that has been circulated by the French Society for Sanitary and Moral Prophylaxis as well calculated to effect the desired persuasion. Mr. Miall, who adds a chapter of his own to his translation of Dr. Héricourt's work, urges that proper instruction should be given in the dangers of venereal disease. Mr. Burke, who has been an acting lieutenant-colonel in the Royal Army Medical Corps, argues forcibly that the public must be made more acquainted with sexual matters, increase its knowledge of the prevalence and dangers of venereal disease, and be induced to appreciate and to assist actively in the means to be provided for treating and finally stamping out of existence those disorders. The education, he says, must begin with the child. The adult must be impressed with the importance, the reality, and the dangers of venereal disease. The medical profession must set its teeth with determination to fight the menace out of existence. Mr. Burke's treatise, which is illustrated by six diagrams, is likely to be of value in effecting the common purpose of enlightening the public on these important matters. E. B.

The Elements of Hardy Fruit Culture.

Practical Hardy Fruit Culture. By Richard Staward. Pp. 216. (London: The Swarthmore Press, Ltd., 1920.) Price 6*s*. net.

ALTHOUGH in many respects this small treatise on hardy fruit culture may be commended to beginners as a clear, concise, and elementary guide on the subject as applied to garden conditions, describing methods followed with success by the author at Panshanger Gardens, Hertford, it cannot be considered as having achieved the main purpose for which it was written. The author has set himself to provide a useful book for those, forming a numerous class at the present time, who are adopting hardy fruit culture as a business and know little or nothing of such work. The methods recommended, however, are essentially those for the private gardener, as distinct from the commercial fruit-grower. Taking the case of distances for planting trees as an example, it is advised that bush or pyramid apples on free stocks should be planted 12 ft. apart, and those on the Paradise stock from 6 ft. to 9 ft. apart. For standard apple-trees 12 ft. is mentioned as the distance, if space is limited. For commercial work these distances should be at least doubled for varieties of vigorous growth, where the trees are to be treated as permanent and not as fillers. A general criticism may also be made of the lists of varieties recommended, which are almost invariably too long, and contain sorts which are of at least doubtful commercial value.

The sections devoted to the diseases and pests of the respective fruits make mention for the most part of the more serious troubles, and of some which are relatively trivial; but there are important omissions, such as silver-leaf of plums, bitter-pit of apples, and reversion of black-currants. The remedies proposed are typical garden methods and are often inappropriate for commercial plantation use. In some cases they would appear to miss the mark entirely, as when, for instance, the spraying of black-currants with lime-sulphur, or, as the author describes it, "bisulphide of calcium," against big-bud-mite attack is advised after the fruit has been gathered. By that time the mites are safely within the cover of the newly formed buds. It may also be questioned whether the author has made the best use of the space at his disposal by dealing with such fruits as outdoor grapes, mulberries, medlars, and apricots, by description of methods of propagation which are not adopted in general practice, and by detailed accounts of the training of special forms of trees which are never considered except for particular purposes in private gardens.

The illustrations are original, and some are of interest.

Our Bookshelf.

Experiments in the Breeding of Cerions. By Paul Bartsch. (Department of Marine Biology of the Carnegie Institution of Washington. Vol. xiv.) (Publication No. 282.) Pp. 55+59 plates. (Washington: The Carnegie Institution of Washington, 1920.) Price 3 dollars.

CERIONS are land snails, well represented in the Bahamas by five species. They occur on the ground, under the edges of stones, among dead leaves, on grass, and on bushes. On an exposed place they attach themselves to the support by a thin epiphragm which also serves to prevent

desiccation. They can æstivate for a considerable time. In habit they are largely nocturnal, and are most active on misty nights. They feed mainly on fungi. They mate on the ground, and, though hermaphrodite, one functions as a male and the other as a female. The eggs are laid singly at the base of tufts of grass and beneath the surface. It takes between two and three years for an individual to reach full maturity.

For experimental purposes a number of Bahama forms were introduced into the Florida Keys, which present a considerable range in climatic factors and vegetation. There is on many of the Keys an indigenous species of Cerion, *C. incanum*, Binney, but it is not nearly related to any of the forms introduced; and one of the interesting results obtained by Dr. Bartsch was that the cross-breeding of the native species with the introduced *C. viaregis* brought about a state of flux. Had the resulted colony been discovered by one who did not know the history, a description would have been given of a very variable species. The inference is that similar complexes of unknown origin are likewise the product of cross-breeding. The case is peculiarly interesting because *C. incanum* and *C. viaregis* are very remotely related. "The fact is, that it is very surprising that organisms presenting such great differences in organisation should be able to cross at all, and it is still more remarkable that they should have produced fertile crosses." The author is inclined to believe that the crossing has an "energising effect" on the new product, but recent work on "hybrid vigour" leads one to think rather that what occurs is a happy pooling of hereditary items which corroborate one another. The general picture the author's results leave in the mind is that species separated for ages might be brought together by changes of level, so that crossing resulted. There followed an efflorescence of new forms which were later subjected to isolation on islands and promontories where inbreeding gradually eliminated diverse characters, eventually resulting in the more or less homogeneous expression which now marks in the Bahamas a multitude of insulated colonies.

Space and Time in Contemporary Physics: An Introduction to the Theory of Relativity and Gravitation. By Prof. Moritz Schlick. Rendered into English by Henry L. Brose. With an introduction by Prof. F. A. Lindemann. Pp. xi+89. (Oxford: At the Clarendon Press, 1920.) Price 6*s.* 6*d.* net.

HERE is a readable book, excellently translated, for which we have again to thank Mr. H. L. Brose. Though it is called an introduction to the theory of relativity and gravitation, it is more strictly an essay on "The Inseparability of Geometry and Physics in Experience," to quote the title of its fifth chapter. The main problem in presenting the work of Einstein to the physicist is to enable him to see how obstinately metaphysical he is.

"Time and space can be dissociated from physical things, and events only in abstraction. The combination or oneness of space, time, and things is alone reality; each by itself is an abstraction." Many will say such statements are metaphysical in nature. In a sense, indeed, any statement is metaphysical which is concerned with logic. The real merit of Einstein's theory is that it does not trouble to ask what space and time are, or how far they may be logically separated from things. It does not attempt the separation. It goes straight ahead, keeping them all together until a result is arrived at which may be tested without any doubt or dispute as to its logical meaning, by the only method of exact observation, the perception of complete coincidence. It renders Newton's highly metaphysical definitions of space and time unnecessary; but while philosophers pause to see how they have to re-model their definitions, the physicist may congratulate himself that history has again proved that the real advances are made by those who, with open mind, continue in their endeavour to order the direct facts of experience in the most comprehensive manner.

History of the Great War, based on Official Documents. By Direction of the Historical Section of the Committee of Imperial Defence: Naval Operations. Vol. i. By Sir J. S. Corbett. Pp. xiv+470+case of 18 maps. (London: Longmans, Green, and Co., 1920.) Price 17*s.* 6*d.* net.

THIS important volume, the first of a series which is expected to run to four or five volumes, is described on its cover as the "official history of the war." This description is modified within by the explanation that, though it is based on official documents inaccessible to the general public, its views and opinions are those of its author alone, for which the Admiralty accepts no responsibility. This explanation unquestionably diminishes the official nature of the publication; but, on the other hand, it immensely increases its historic interest and its scientific value. For Sir Julian Corbett is a master of naval lore; he is deeply versed in the strategy and the tactics of the great captains of the old days. Consequently he has come to the study and interpretation of the masses of information concerning the late war laid before him by the Government with a splendid reserve of knowledge and with a perfected apparatus of criticism, and it is eminently satisfactory to be assured that he has had a perfectly free hand in dealing with his material and in drawing his conclusions.

The volume deals in a most illuminating manner and with a wealth of new information with the situation at the outbreak of the war, with the problems which the Navy had to face and solve during the critical months of 1914, and finally with the thrilling battle of the Falkland Islands. We await with eager anticipation the remaining volumes of the series. The maps, it may be added, are of the highest value and importance.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Constitution of the Elements.

IN continuation of my letter in NATURE of March 4, further experiments on mass-spectra have been made, the results of which may be briefly announced as follows:

Boron (atomic weight 10·9) is a complex element. Its isotopes are 10 and 11, satisfactorily confirmed by second-order lines at 5 and 5·5. Fluorine (atomic weight 19·00) is apparently simple, as its chemical atomic weight would lead one to expect.

The results obtained with silicon (atomic weight 28·3) are somewhat difficult to interpret, and lead to the conclusion that this element has isotopes 28 and 29, with possibly another 30.

Bromine (atomic weight 79·92) is particularly interesting, for, although its chemical atomic weight is so nearly 80, it is actually composed of approximately equal parts of isotopes 79 and 81.

Sulphur (atomic weight 32·06) has a predominant constituent 32. Owing to possible hydrogen compounds the data are as yet insufficient to give a decision as to the presence of small quantities of isotopes of higher mass suggested by the atomic weight.

Phosphorus (atomic weight 31·04) and arsenic (atomic weight 74·96) are also apparently simple elements of masses 31 and 75 respectively.

No line given by the above elements shows any measurable divergence from the whole number rule.

F. W. ASTON.

Cavendish Laboratory, June 20.

Applied Science and Industrial Research.

IN my reply to Mr. Williamson, published in NATURE of June 3, I stated that research workers and their assistants, aided by the Department of Scientific and Industrial Research, during the year 1918–19 received on the average 53*s*. weekly.

Sir Frank Heath has directed my attention to the unwarranted inference I have drawn. I assumed that the grants made were all annual grants, but I am informed by the Department that this is not the case; less than half the grants to research workers and students were grants for twelve calendar months' work; the sum of 14,170*l*. expended included nine grants for apparatus and grants for casual labour. Actually, eighty-five research workers and students received rather less than 13,000*l*. I am informed also that professors' recommendations are followed in making these grants, both with regard to recipients and to the amounts allotted.

Without expressing any further opinion as to the adequacy of grants to individuals, detailed information not having been supplied, I should be glad if you would afford me the opportunity of expressing my regret that in criticising the grants I unwittingly misconstrued the figures given on pp. 9 and 72 of the Report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1918–19.

A. G. CHURCH.

National Union of Scientific Workers,
19 Tothill Street, Westminster,
London, S.W.1, June 21.

Science and Scholasticism.

DR. SINGER'S review of my book "Medieval Medicine" in NATURE of April 1 has only just come under my notice. The mails separate us from England more than before the war; may that be my excuse for a belated word? I have nothing to say for the book, it is thoroughly documented and must speak for itself; but may I say a word for poor Aristotle and Hugo da Lucca, whom I have brought under the reviewer's strictures?

Dr. Singer suggests that Aristotle has come into appreciation again because we have found that he made observations on animal life. Is not the reason rather that now that we ourselves have come to think through our observations to the principles beneath, we have found that Aristotle was usually before us? As Prof. Wundt said, after spending a lifetime at experimental psychology: "It is only the animism of Aristotle which, by joining psychology to biology, provides a plausible metaphysical explanation for the data furnished by experimental psychology." In nearly everything else where this generation has thought deeply enough they have found Aristotle before them whenever he had considered the subject. That is why we have come to appreciate better the medieval regard for him.

Hugo da Lucca must be allowed to rest on his own work just like Aristotle. Any man who operated on the skull, the thorax, and the abdomen seven hundred years ago, using a metal tube to secure the patulousness of the intestines while he was making an intestinal anastomosis, who got union by first intention and boasted of it, and whose cicatrices were "pretty and linear, so that they could scarcely be seen," may be trusted to posterity in our time. How he could have done such things without an anæsthetic is impossible to understand, so therefore the hints that we have of anæsthesia at that time must be taken as historic. We do not need to go to manuscripts for this; there are dozens of text-books of professors of surgery in the thirteenth century that were printed in the Renaissance time. The Renaissance printers had marvellously good judgment, and the authors they printed in their magnificent editions were worthy of the time and labour they devoted to them. We have no word from Hugo himself, but his son wrote a whole volume with regard to him which surely Dr. Singer must know, though it is very hard to understand the position that he takes if he does know of it.

It is always amusing to note how the saying of anything good about the Middle Ages arouses opposition. John Fiske's declaration, "there is a sense in which the most brilliant achievements of pagan antiquity are dwarfed in comparison with these (of the Middle Ages)," must wait for acceptance. When I ventured to say in a volume on "The Thirteenth the Greatest of Centuries," that they had fine technical schools and developed engineering, most people shied; and yet we have their stained glass, illuminated books, wonderful ironwork, carving, and all the rest that we are founding technical schools to secure, and the engineering of their bridges and cathedrals is a marvel.

The modern man of science balks at this. Here in the United States the authors of "A Short History of Science" (New York, 1918), professors at the Massachusetts Institute of Technology, treated the science of the Middle Ages in a couple of paragraphs, the most important part of which is: "In the thirteenth century it becomes plain that a new spirit is arising in Europe. . . . Thomas Aquinas writes his famous 'Imitatio Christi.'"

JAS. J. WALSH.

110 West 74th Street, New York, May 26.

THE dialectical methods of the Middle Ages, admirably adapted to the sharpening of wits and the entertainment of audiences, have long been regarded by men of science as an inferior means of arriving at truth. I have no wish to enter into controversy with my friend Prof. Walsh as to the general merits of Aristotle. Yet I will venture to sum up in a sentence what I believe to be the conclusions of the overwhelming majority of modern Aristotelian scholars and of scientific men who have investigated the works of the master: *Aristotle's physical science is almost worthless from the modern point of view; it has scarcely any serious basis of observation and none of experiment; his biological works, on the other hand, show him to have been an admirable and careful observer of animal life.* He was thus an excellent naturalist but a very poor physicist. I will further endeavour to epitomise the verdict of most scientific students of the Middle Ages on his position in medieval science. *It was chiefly Aristotle's physical works that earned for him his scientific reputation in the Middle Ages; his biological works exerted little influence until the sixteenth century.* Those who assent to these propositions will not agree that "we have come to appreciate better *medieval* regard for him."

As regards Hugh of Lucca, I am aware of the existence of the "Chirurgia" of Theodoric, and that he was perhaps the son of Hugh, though, to my mind, Prof. Walsh has greatly exaggerated the scientific value of his work. But Theodoric's treatise, though certainly very interesting to us, was not greatly prized by the Middle Ages. Hence copies of it are very rare, and among the fifteen thousand or so medical MSS. that have survived in this country only one (Ashmole 1427, fourteenth century) contains it. A treatise possibly founded on it has survived in one English codex of somewhat later date (Magd. Coll. Cambridge, Pepys, 1661). Theodoric's treatise was not printed until 1498. I see nothing in it, or in what Prof. Walsh now says of it, to justify a modification of my criticism. The English reader who cares to learn more of Theodoric will find a sympathetic account of him in Sir Clifford Allbutt's "Historical Relations of Medicine and Surgery," and a very full analysis of his "Chirurgia" in E. Gurlt's "Geschichte der Chirurgie."

The judgment of the Renaissance printers in their selection of medical works is a matter of opinion. The sixteenth century had run a quarter of its course ere they made Hippocrates accessible (earliest Latin edition, Rome, 1525; earliest Greek edition, Venice, 1526). By that time the ponderous "Kanun" of Avicenna had already passed through at least twenty-two editions (Editio princeps, Strassburg, 1472). Those who rate Hippocrates higher than Avicenna—or than Theodoric—will rate the judgment of the Renaissance printers—and readers—accordingly.

Against Prof. Walsh's suggestion that I am opposed to any good being said of the Middle Ages I am sufficiently protected by my published works. However these be estimated, they will yet, I hope, guard me against the accusation of having neglected that period. Under such protection as they may afford I would add my regret to that of many of Prof. Walsh's other admirers that he does not use his great learning and literary gifts to portray medieval life as it was instead of as that of a *Civitas Dei*, which it was not. Whatever the scientific aspirations of the age, the scientific achievement was very small. The explanations of this failure are various, but in denying the fact Prof. Walsh belongs to an exceedingly small band of scholars whose conclusions seem also, to some of us, to be shaped by certain preconceived ideas. But we shall not, on that account, value the less any contribution to knowledge that he may make.

Oxford, June 12. CHARLES SINGER.

Commercial Parasitism in the Cotton Industry.

THE opinion of Sir George Watt in NATURE of February 23 that the report to the Board of Trade of the Empire Cotton Growing Committee is "ingeniously elaborated," but leaves a "confused impression," may justify a brief consideration of an allied phase of the subject. Why "the whole history of cotton improvement is most disheartening" may be explained if an essential feature has been omitted. The argument for research is ably presented in the pamphlet issued at Manchester by the Provisional Committee on Research and Education for the Cotton Industry, but with no reflection of the actual state of production.

Not only should planters have industrial information, as recognised in Sir George Watt's proposal of a central research institution at Manchester, but on the part of manufacturers, financiers, economists, and commercial leaders there is acute need of agricultural information. Industrial interest in cotton improvement must be made effective through the commercial channels that lead back to the farmer. Problems of agricultural application must be solved, in addition to developing superior varieties, devising better cultural methods, and controlling diseases or insect parasites. The elaboration of the cotton research programme may be entirely logical, but without an effective tie-back to the farmer there can be no prospect of a general application of the results of technical investigation, either industrial or biological, to purposes of production.

The central cotton institution at Manchester should be equipped for any elaboration of research that may be necessary to determine and demonstrate to manufacturers the relation of the system of buying to the improvement of production. The parasitic tendencies of the present commercial system are not limited to the speculative features that are being restricted by law or to the taking of undue profits, but lead to enormous agricultural and industrial waste through the production and manufacture of inferior fibre, passed on to the consumer in weaker and more perishable fabrics.

To expect manufacturers to be interested in the cotton plant or in the details of farm operations in the growing of cotton might be unreasonable, but at least the financial aspects of cotton production would receive attention if manufacturers knew how their interests are prejudiced by the present commercial system. Instead of serving as a conductor of interest in improved production from the spinner to the farmer, the commercial system has the manufacturers and the growers fenced apart and misinformed regarding the general needs of the industry.

Manufacturers are accustomed to pay more for good cotton, and naturally suppose that the farmers who raise better fibre receive higher prices for their crops, but investigation will show that most of the profit is absorbed by the buyers. The commercial idea of improving cotton is by "classing" the present miscellaneous crop into the so-called "even-running lots." Buyers like to get long-staple bales at short-staple prices, but do not forgo present profits in order to encourage the improvement of future crops that somebody else may buy. The commercial system provides no incentive for improved production.

The farmer is at liberty, of course, to raise better cotton if he chooses, but extra care and expense must be given, with no assurance of being able to sell at a higher price. Instead of gaining an advantage or of being encouraged to continue the planting of a better

variety, the progressive farmer at the end of the season may find himself making a forced contribution to an unjust system. Naturally, he loses interest in raising cotton of better quality, and goes back to ordinary "gin-run" seed or to the shortest and most inferior variety that promises a large yield.

There is no agricultural reason why any part of the American cotton belt should produce less than inch staple, nor is it an advantage to any interest that the production of inferior, short, and irregular staple should continue, but the inertia of the system must be overcome. If longer and more uniform staples are to be grown, they must sell at least as readily and as profitably as short staples. Since the farmer makes no use of cotton at home, but raises it only to sell, the quality of the fibre is of interest to him only as the price is affected. Better prices for better cotton are the only inducements that the farmer should be expected to consider. Preaching from any other text is sure to fall on deaf ears.

The present scarcity of superior fibre could be met most promptly and effectively by having more good cotton grown instead of wasting the resources of production by planting inferior cotton. The real obstacle is a defective commercial system, which undoubtedly could be changed without any great difficulty if the manufacturers had sufficient understanding of the conditions and needs. The problem, no doubt, is much the same in other countries as in the United States: to render production more efficient by improving the quality of the crop.

After two decades of investigation of cotton-breeding problems in the United States it is being recognised that the production of the best and most uniform fibre can be maintained only in communities that limit their production to a single variety of cotton, so that there shall be no mixing of different kinds of seed at the public gins or crossing of different kinds in the field. One-variety communities have been maintained for several years in the Salt River Valley of Arizona, where the practical advantages of the plan have been demonstrated and the commercial obstacles more clearly revealed.

Community production of better cotton in other regions might go forward rapidly if farmers were assured of better markets for good cotton than for short, mixed fibre. High prices may be expected to affect the quantity of cotton to be grown, but the quality will not be improved unless there is a distinct advantage in raising better cotton. So long as manufacturers are willing to take the present commercial system entirely for granted, and overlook its effect upon production, no prompt or general improvement is to be expected.

Lack of discrimination in buying from the growers is the weak point of the present system, not to be made good by paying all growers more for their cotton, but by paying more for good cotton and less for poor cotton. Discrimination in prices must be applied in the primary markets instead of the present careless and incompetent buying of "hog-round" lots at "flat" prices, which leads the farmer to produce the worst fibre instead of the best, because varieties with inferior lint often yield well or turn out high percentages of lint at the gin, and do not need such careful handling as the longer staples.

Not only the condition or "grade" of the cotton, but also the quality or "staple" need to be recognised while the cotton is still in the hands of the farmer. Outside of cotton markets it is seldom understood that the grades used in buying cotton from farmers have no relation to the essential textile qualities of length, strength, and uniformity of fibre, but only to incidental differences that result mostly from careless picking or from exposure to the weather. The system buys grades from the farmer, but sells staples to the manufacturer, getting discounts from the farmer and premiums from the manufacturer.

Discrimination could be applied honestly and to the best advantage on the farm before the cotton is picked. Uniformity of the fibre, which is an essential factor of quality and value for textile purposes, can be determined much more readily and definitely while the cotton is still in the field than after it is brought to the gin or passed into the bale. Field inspection of the plants shows readily and easily whether the stock represents a select, uniform variety or is mixed with plants that yield only short, inferior fibre, as most of the "off" plants do when a good variety is allowed to deteriorate through admixture or neglect of selection.

If the cotton is mixed and irregular in the field there is no chance that the farmer will have high-quality fibre to sell, although the average buyer could not determine the admixture from the bale samples. The careless farmer usually sells his cotton at the same price as his more careful neighbours, to say nothing of the dishonest farmer who deliberately grows a mixed field with 20 per cent., or even 50 per cent., of short cotton, but gets the long-staple price for his crop.

The quality of the fibre is affected also by cultural conditions of soil, season, and methods of handling the crop. Even on the same farm or in the same field inequalities of soil or treatment may result in cotton of very different textile qualities, which would be marketed in separate bales if adequate discrimination in buying made such precautions worth while to the grower. The careful discrimination of quality that should be applied in the field can be made good only in part by the elaborate mill-tests by which the manufacturers try to protect themselves against too much waste and breakage in working the cotton. Such losses, as well as costs of cleaning and combing processes, undoubtedly could be reduced to a great extent through more careful buying and the more careful growing and handling of the crop which discriminating treatment of farming communities would secure.[1]

Field-inspection buying may be considered as a new application of botanical knowledge, but the underlying facts have been established, and there is no reason to doubt that the talent applied in commercial sampling from bales could be used more effectively for determination of the quality of fibre before the cotton is harvested. Such a reform would give the commercial system a positive, constructive relation to the industry instead of the present negative, parasitic relation. Farming communities would turn at once to the production of fibre of better quality, to the general advantage of the cotton industry and the consuming public. No doubt the relation of prices to production has been overlooked because it is so simple and obvious, but a new approach is open to manufacturers through the organisation of one-variety communities. A strong department of commercial relations in the new Cotton Research Institute at Manchester would be a practical recognition of the principle approved by Sir George Watt: "The cultivator's interests are paramount."

O. F. COOK.

Bureau of Plant Industry, Washington,
May 24

1 See United States Department of Agriculture Bulletins, "The Relation of Cotton Buying to Cotton Growing," "Cotton Improvement on a Community Basis," "Cotton Selection on the Farm by the Characters of the Stalks, Leaves, and Bolls," "Extension of Cotton Production in California," "Production of American Egyptian Cotton," and "Maintaining the Supply of Cotton."

Fuel Research.

By PROF. JOHN W. COBB.

THE rising cost of coal will help to focus attention upon all such potential relief work as that of the Fuel Research Board, which has now issued its 1918–19 report over the signature of its director, Sir George Beilby. The report is of a comprehensive character, and gives evidence both of care in preparation and of a desire and competence to grapple in a scientific and effective manner with some of the more important problems with which the country is faced. The Board is not only undertaking experimental work at a station established for the purpose at East Greenwich, and conveniently placed near a works of the South Metropolitan Gas Co., but is also concerning itself with inquiries conducted elsewhere into the thermal efficiency of open fires and cooking ranges, the economic position of pulverised coal, the cutting, winning, and utilisation of peat, and the sources of raw material for the production of power alcohol. The report also includes a reasoned account of the proceedings of the Board in the matter of the new gas standards which had been wisely referred to it by the Board of Trade and on which it has made recommendations. A survey of the national coal resources from the physical and chemical points of view is promised, this work having been taken over from the Coal Conservation Committee, which recognised the importance of such a survey, but, being without a staff, did not feel able to carry it out.

The equipment and lay-out of the experimental station at East Greenwich are described at some length. Stress is laid upon measures taken to allow of striking a correct thermal balance for each piece of plant employed, although it is no doubt recognised that the smallness of each unit would have to be taken into account in translating results into terms of large-scale practice. It is interesting to note that the position of water-gas as a heating agent for such purposes as the firing of the gas-retort installations is now so far established that the Board has felt justified in making blue-water-gas its standard fuel. Recent experience has demonstrated that the traditional restriction in the use of water-gas to operations requiring intense local heat was unnecessary.

Apparently the first purpose to which the experimental plant is to be put is the complete investigation of low-temperature carbonisation, concerning which so many conflicting statements have been put forward. This is a very legitimate inquiry, and the report justifies it (if any justification is needed), by insisting upon the wisdom of probing all possible sources of supply for the fuel oil on which the Navy and mercantile marine are becoming increasingly dependent. It is plain that Sir George Beilby approaches this process with some predisposition in its favour. He has himself made preliminary experiments upon it, and in an appendix to the report there is reprinted a contribution which he made to the discussion of the subject at the British Association meeting in 1913. The report displays a somewhat unfortunate tendency to rule out the carbonisation processes of the gas industry as being unlikely to produce larger quantities of fuel oil, because "present movement is all in the direction of obtaining the highest possible proportion of the total thermal units of the coal in the form of gas with a smaller consumption of coal per million thermal units distributed." Such ruling out is not justified, as a later qualifying clause admits. The further technical success of the gas industry would be expected to result in a large replacement of coal as a domestic and industrial fuel by gas, and although the thermal units carried by the gas from a ton of coal would increase, the margin for replacement is so considerable that the total amount of coal *gasified* would increase also. Moreover, it is unwise to assume that such developing processes as the distillation in vertical retorts of a descending stream of coal in an ascending stream of steam or other gas cannot be made a most effective and economical means of securing the maximum yield of volatile products, including tar oils if they are wanted. Most of the favourable "non-destructive" conditions claimed for low-temperature carbonisation may quite probably be secured in this way without the attendant disadvantages of that process as it has so far been described and worked. The whole matter is still *sub judice*.

The net commercial result of any carbonisation process is to a great extent dependent upon the relative market values of products, which change from time to time. From a thermal point of view, however, the movement towards obtaining a large proportion of the thermal units of the coal in gas is justified by the high thermal efficiency of gas in use, combined with the low thermal cost of production which can be made to attach to it. From the point of view of by-products, fuel oil has, no doubt, its importance, but it would be a mistake if sulphate of ammonia were to be deposed from its pride of place without due consideration, and it seems clearly to be established that low-temperature conditions are very unfavourable for the production of ammonia. It may be that national safety will be held to demand the working of a commercially unremunerative process, but, if so, the decision should be made with open eyes.

The results which Sir George Beilby, Prof. Thomas Gray (chief of the laboratories), and their staff are setting out to obtain in connection with the low-temperature carbonisation process will be of great interest to many who have been waiting for trustworthy data concerning it. The commercial success of low-temperature carbonisation on an extended scale is bound up with the creation of a demand for the soft coke or semi-coke which would be one of its main products. As compared with raw coal, this material, like any other coke,

would have the outstanding advantage of smokeless combustion, but its ash content would, of necessity, be higher. It would have the great disadvantage of crushing more easily than ordinary coke in all the processes of transference from the retort to the consumer, but would be correspondingly easier to ignite. Like both raw coal and ordinary coke, it would deliver potential heat units at a cheaper rate than they are supplied in gas. The question of efficiency in use remains, and the report deals benevolently with the efficiency obtainable from coal and coke in the most widely used domestic appliance—the open fire. It is set out that with an open fire, which has apparently a chance of regaining a lost reputation if it will only consent to provide a market for large quantities of soft coke, "probably 30 to 40 per cent. of the heat escapes completely, 60 to 70 per cent. being used in warming the room itself and the general fabric of the building."

On this point careful statement is advisable. In view of the comparative unavailability of any heat from the coal fire which is not given up to the room, it would be quite wrong to take 60 to 70 per cent. as being the thermal efficiency of the open fire, just as it would be wrong in the other direction to take the radiant efficiency of such a fire (about 25 per cent.) as the total efficiency. Comparative tests are probably best made on radiant efficiency, and it is not surprising to find that the tests made by Dr. Fishenden and quoted in the report are made on this basis. Dr. Fishenden's tests on coal and coke fires have been carried out at Manchester by the method worked out at the University of Leeds for testing the radiant efficiency of gas fires, with such modifications as were found necessary. The work has undoubtedly been carried out with care and skill, but it should be borne in mind that, on account of the varying condition of a coal fire during the course of a determination, the quantity and distribution of radiation from it cannot be measured with anything like the same degree of precision as with a gas fire. Dr. Fishenden does seem to be satisfied, however, that the radiant efficiency of the coke fire is higher than that of the coal fire, and, according to the report, "the radiant efficiency of coal fires of different types varies from 19½ to 25 per cent., while, with fires of low-temperature coke in the same grate and burning under the same conditions, this amounts to 31 to 34 per cent." It may be noted that the radiant efficiency of a modern gas-fire is approximately 45 to 50 per cent., but the report does not fail to point out that the real thermal advantage of the gas fire is much greater than would be indicated by any such comparison, because it can be used almost immediately at full efficiency for any period of time, great or small, this, of course, apart from any question of labour-saving and cleanliness. Cooking ranges were brought under test by Mr. A. H. Barker, and his reports are summarised in an appendix. "Mr. Barker lays stress on the extravagance in fuel involved by the necessity of heating the whole apparatus in the use of only one or possibly two of its appliances," and points out the further difficulty of obtaining high economy under ordinary working conditions because of the large excess of air employed.

It is plain that, whether coke or gas is used as a means of replacing raw coal for domestic uses, the smoke nuisance would be abated, and a section of the report given under the head "Air Pollution" shows this aspect of the fuel problem to be receiving attention from the Board. The pioneer work of Prof. J. B. Cohen (which should not be overlooked) was of great service in directing attention to the considerable quantity and evil effects of smoke in our atmosphere, and observations have since been multiplied by the Atmospheric Pollution Committee of the Meteorological Office, Dr. J. S. Owens, Mr. William Thomson, and others whose work is referred to in this report. The appointment of properly trained inspectors whose help and advice would be welcomed by industrial consumers of fuel is advocated, in addition to the establishment in every large works of an organised fuel control as the "only solid foundation on which to build more revolutionary or further-reaching methods of fuel economy."

It is pointed out usefully that soot from the burning of raw coal, ash and dust from the burning of coal or coke, and acid impurities derived from the sulphur contained in coal, coke, and unpurified gas, are all to be taken into account in a consideration of atmospheric pollution resulting from the use of fuel, and it may be emphasised that the liability to pour out large quantities of fine ash into the atmosphere is not to be overlooked in considering the advantages and disadvantages of pulverised fuel. The use of pulverised coal has not been developed in this country to the same extent as in America, and, therefore, although the Board is putting down a small plant in order to make experiments at East Greenwich, it has thought it advisable to secure full information upon the subject through a report made by Mr. Leonard Harvey after a special inquiry conducted in America. Mr. Harvey visited important installations and collected there the experiences and views of the leading consumers of pulverised coal. His report has already been issued separately. "The advantages of the method as an almost perfect means of burning coal must be weighed against the cost of producing and handling coal-dust and the difficulties which may have to be overcome in dealing with its ash."

Another special inquiry has been directed to the subject of peat. This work has been carried out mainly in Ireland, and has undergone vicissitudes, but a beginning seems to have been made, and reference is made to a paper, read before the Royal Dublin Society in March last, in which Prof. Purcell gave an admirable summary of the peat situation, not only in Ireland, but also in other countries. It is interesting to note, as indicating elasticity of method, that this paper will be printed as one of the special reports of the Fuel Research Board, and also that the help of the Department

of Scientific and Industrial Research has apparently been accorded for the production of an English translation by Prof. Ryan of Hausding's "Handbook on the Winning and Utilisation of Peat."

As regards fuel alcohol, the position is summarised thus: "It is obvious that until an estimate has been made of the possible resources for the production of alcohol within the Empire, and until their probable amount and the cost of using them have been ascertained, it would be useless to embark upon research on any extended scale into methods of production or utilisation."

The report, under the head "Gas Standards," gives a summary of the steps taken by Sir George Beilby and the Board from the time they were asked to advise on the subject by the Board of Trade, which recognised the complete inapplicability to modern conditions of gas standards as they had existed before the war. Conferences were held with those interested in the matter in different ways, and at a final conference resolutions were put and adopted which were forwarded to the Board of Trade, and constitute a new and much more rational method of regulating gas supply by statute. The central principle is that the consumer shall be charged with the potential thermal units supplied to him in the gas. The permissible percentage of inert constituents is limited by another resolution, although, of course, the temptation to pull "inerts" into the gas is removed now that they have to be distributed at the same cost as combustibles, but have not to be paid for. The gas undertaking can decide on the calorific value of the gas it intends to deliver, a power which should open the way for extensive technical development of the industry, and allow of the realisation of economies which have hitherto been rendered impossible by useless and out-of-date restrictions. The refusal of Sir George Beilby and the Fuel Research Board to accept any restrictions in this regard, however pertinaciously and dogmatically they were put forward, unless they could be justified by some adequate reason, has exemplified in a striking way the advantage of referring a matter of this kind to a competent technical authority. The choice of a new standard is a new degree of freedom, but, the choice being made, the gas undertaking is required to adhere very closely to it. Recognition is here given to the valid principle that unsatisfactory performance of a gas-using appliance is far more likely to be due to variations from the standard than to any lowness (or highness) in the standard itself. It is recognised that if the standard is materially altered the burners in consumers' appliances may need alteration, and the gas undertaking has to make the adjustment. "The calorific value of the gas is to be continuously measured and recorded by a recording calorimeter of a standard type to be passed by the London Gas Referees," and by this means it is hoped that the control of gas quality can be made much more effective than it has been hitherto.

Sir George Beilby has had under observation for some time the Simmance recording gas calorimeter with apparently satisfactory results, but the strain will come when legal penalties are dependent upon the accuracy (or inaccuracy) of this or any other form of recording gas calorimeter. Presumably, however, the possibilities of error will receive full investigation, and the successful working of so promising a scheme for the regulation of public gas supply will not be endangered by the imposition of any rigid system of testing which is not one of fully proved trustworthiness.

Use of Sumner Lines in Navigation.[1]

By CAPT. T. H. TIZARD, C.B., F.R.S.

THE Sumner line as a means of aiding in the navigation of ships has been in use for certainly seventy years, and is one of the best methods of obtaining the position of a ship at sea, for by its means both latitude and longitude can be obtained simultaneously without difficulty, and it has certain other advantages. In obtaining both latitude and longitude simultaneously, observations of more than one heavenly body are required, and the Greenwich time must be known accurately, as well as the approximate latitude. The altitudes of two or more heavenly bodies can be observed at twilight, both morning and evening, when the weather is clear, the horizon distinctly visible, and the stars are yet to be seen before the sky is lit up by the sun. It is possible, too, even without using the Sumner line, to observe in daylight meridian altitudes of Venus or Jupiter if they cross the meridian at least two and a half hours before or after noon, and occasionally both sun and moon are available during the day. In northern latitudes the pole star is always available in clear weather, at twilight, for observations for latitude, and one or two other stars for longitude, but if neither the pole star nor a heavenly object near, or on, the meridian is available for obtaining the latitude, Sumner's method affords a means of doing so.

Sumner's method briefly is as follows: If a straight line be drawn from the centre of the earth to any heavenly body, at the spot where this line cuts the circumference of the earth, the altitude of that heavenly body will be 90°, which spot is named by Mr. Comstock the sub-polar point; a more appropriate name would be the zenith point—that is, the point on the earth's surface where the heavenly object observed would be in the zenith; and if circles be drawn on the earth's surface round this spot, with it

[1] "The Sumner Line or Line of Position as an Aid to Navigation." By G. C. Comstock. Pp. vi+70. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1919.) Price 6s. net.

as a centre, those circles are really circles of altitude of the heavenly body; so that when an observer takes an altitude of a heavenly body he is on a circle of altitude, and his position

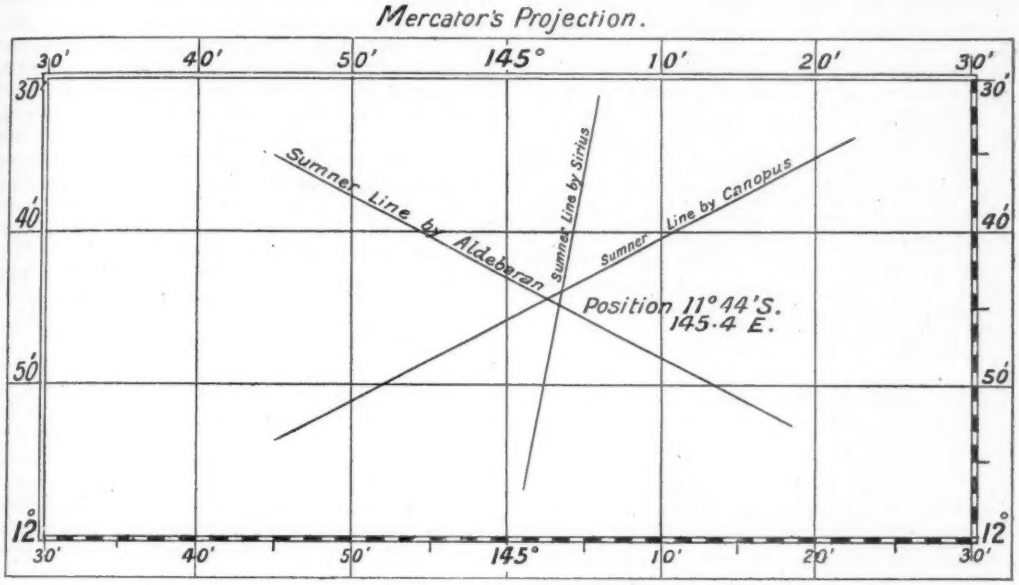

FIG. 1.

on that circle can be obtained by taking simultaneous altitudes of two heavenly bodies, or, in other words, of obtaining two circles of altitude which cut each other at a suitable angle, and the spot where they cut each other is the required position of the observer. The circles of altitude are of such a great radius that for short distances they are practically straight lines. There are two methods of obtaining the position of sections of these circles of altitude, or Sumner lines. In both it is necessary to know the exact Greenwich time, the approximate latitude, and the exact declination of the heavenly object. These are always available in a ship provided with a chronometer and a Nautical Almanac.

The first method is to assume two latitudes, one, say, 10 miles north, and the other 10 miles south, of the approximate position, and with each latitude, combined with the altitude and polar distance, to calculate the longitude, a process familiar to all navigators; then plot the two positions thus obtained and draw a line on the chart joining them, and the observer must be on that line. With observations of another heavenly body, and using the same latitudes, go through the same process, and the observer's position will be on the spot where the two lines cross each other. If it is very important to avoid error—as when sailing towards narrow channels through coral reefs, such, for instance, as the Raine Island passage through the Great Barrier Reef in Australia—observations of a third star can be taken, and the resulting Sumner line should coincide in cutting the other two lines in, or close to, the spot already determined.

The second method of obtaining the Sumner line is to use only one latitude, and to calculate the longitude and the azimuth, or true bearing, of the heavenly body; then, as the circle of altitude, or Sumner line, is at right angles to the true bearing, already calculated, by plotting the

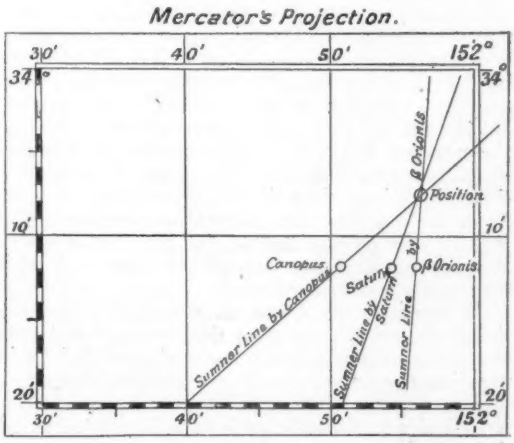

FIG. 2.

latitude and longitude and drawing lines at right angles to the true bearing, the position of the observer is where those lines cut each other.

The following examples illustrate the methods:

(1) On August 30, 1874, when H.M.S. *Chal-*

lenger was making for the Raine Island passage, observations were taken at 5 a.m. of Aldebaran, Sirius, and Canopus, and the latitude was assumed to be 11° 40′ S. or 11° 50′ S. Using these latitudes, the position of the Sumner lines was found to be as shown in Fig. 1, and the position of the vessel to be 11° 44′ S., 145° 4′ E.

(2) On June 13, 1874, observations were taken at 6 a.m. (to fix the position of a deep-sea sounding) of β Orionis, Canopus, and Saturn, the latitude being assumed as 34° 12′ S., the resulting longitude by β Orionis being 151° 56′ E., and its azimuth S. 86° 26′ E., the Sumner line therefore running N. 3° 34′ E. and S. 3° 34′ W. The longitude by Canopus was 151° 50′ 45″ E., and its azimuth S. 39° 18′ E., its Sumner line running N. 50° 42′ E., S. 50° 42′ W.; the longitude by Saturn was 151° 54′ 15″ E., and its azimuth N. 73° W., and the Sumner line by it running N. 17° E., S. 17° W. These lines are shown in Fig. 2, and the position of the sounding was lat. 34° 8′ S., long. 151° 56′ E.

But the Sumner line has another advantage. When only one heavenly body is visible, and, therefore, the exact position of the observer cannot be obtained, if with an assumed latitude the longitude and azimuth be calculated, and the resulting Sumner line be plotted on the chart, if this line runs in the direction of the port, or point of land, towards which the ship is sailing, by steering along the Sumner line the vessel will reach her destination. For instance, if when sailing towards the English Channel an observation of the sun be obtained in the forenoon, when its azimuth, or true bearing, is somewhere between south and east, the Sumner line will be between east and north; and if this line runs towards the Lizard or some other known point, by steering along this Sumner line a good landfall may be obtained.

Obituary.

DR. F. A. TARLETON.

FRANCIS ALEXANDER TARLETON, who died on June 20, was born in Co. Monaghan in 1841. He was the youngest son of the late Rev. J. R. Tarleton, of the Established Church in Ireland, and received his earlier education from his father. At the age of sixteen he entered Trinity College, Dublin. He was in the same year as the late Sir Robert Ball, whom he defeated at the moderatorship examination in mathematics in 1861, taking also a junior moderatorship in logic and ethics. Elected to fellowship in 1866, and called to the Bar in 1868, he was for a time assistant to the professor of applied chemistry, and professor of natural philosophy from 1890 to 1901, when he was co-opted a senior fellow. From that time until a few days before his death he sat as an efficient member of the board of Trinity College. Dr. Tarleton held several college offices, including those of senior bursar, senior lecturer, and senior dean, the last being a sinecure—for its statutory duties have long since lapsed. As senior bursar he showed his qualities as a first-class financier. He was at one time president of the Royal Irish Academy, and a member of the Board of Irish Intermediate Education.

As professor of natural philosophy, Dr. Tarleton followed the traditions of his distinguished predecessors, Williamson, Townsend, and Jellett, in treating the subject from a strictly mathematical point of view. Although he had a considerable practical acquaintance with experimental science, he flatly ignored the judicial aphorisms of Francis Bacon, and, instead of treating mathematics as the handmaid of physics, he rather inverted the order, and almost succeeded in reducing hydrodynamics, elasticity, magnetism, and electricity to branches of pure mathematics.

The writer attended Dr. Tarleton's moderatorship and fellowship lectures about twenty years ago in hydrodynamics, elasticity, and the electromagnetic theory of light, and was struck with wonder at his extraordinary memory and accuracy. For two and a half hours he would write down long and intricate calculations without the aid of any notes. Sometimes a student at the end of an hour would ask to be allowed to leave in order to attend a lecture in experimental science or history or other subject, and Dr. Tarleton would say with a snarl and a grimace (covering a heart full of humour and humanism): "Waal, if you prefer that *abominable* subject to mathematics, you are welcome to leave, and we're glad to get rid of you."

The last time the writer spoke to him, Dr. Tarleton expressed his intense dislike of Einstein's theory of relativity. He held that the Newtonian and Kantian conceptions of space and time are good enough to explain all possible phenomena, if sufficient mathematical ingenuity is shown, and he placed relativism in the same category as Bolshevism.

Dr. Tarleton wrote the following papers:—"On the Solid of Revolution having a Given Volume which experiences the Least Resistance in Passing Through a Medium," "Chemical Equilibrium," "Deductions from MacCullagh's Lectures on Rotation," "The Foundations of the Science of Number," "Notes on Crystallography," "Geometrical Proofs of Some Properties of Conics," "The Harmonic Determinant," "Laplace's Coefficients," and "A Problem in Vortex Motion." His two books "Dynamics" (written in conjunction with Williamson) and "An Introduction to the Mathematical Theory of Attractions" are first-class text-books of their kind. The latter contains a chapter on Maxwell's electro-magnetic theory of light.

R. A. P. ROGERS.

GEOLOGISTS will regret to learn that DR. WHEELTON HIND died on June 21. Dr. Hind was born at Roxeth, near Harrow, in 1860, and graduated in medicine and surgery in the University of London, also gaining the fellowship of the Royal College of Surgeons. He began practice at Stoke-on-Trent more than thirty years ago, and soon occupied a prominent place among the surgeons of North Staffordshire. His recreation from the first was field-geology, which suited both his athletic activity and his eagerness for purely scientific work. His early studies coincided with the movement initiated by Lapworth and others for the more exact correlation of stratified rocks by a very detailed study of their contained fossils; and Dr. Hind proceeded to apply this new method of "zoning," as it was termed, to the Carboniferous rocks of the neighbourhood in which he resided. His success in discovering the regular order in which the different assemblages of fossils occurred in Staffordshire and Derbyshire gradually led him further afield. He co-operated with members of the Geological Survey, and after extended researches in Lancashire and Yorkshire he joined Mr. J. Allen Howe in 1901 in contributing to the Geological Society of London a fundamentally important memoir on the classification of the Lower Carboniferous rocks of north-central England. Dr. Hind also recognised that, for the purposes of the stratigraphical geologist, the species of Carboniferous Mollusca needed more exact definition than had previously been attempted, and he devoted much labour to adding two finely illustrated monographs on the subject to the series published by the Palæontographical Society. Some of the molluscs proved to be of value for recognising the various seams of coal in the Staffordshire coalfield, and in 1903 Dr. Hind and Mr. J. T. Stobbs prepared an illustrated wall-chart of them for the use of the practical miner. On the outbreak of war in 1914 Dr. Hind joined the Army as a gunner, and took part in some engagements in France; but he was afterwards employed as surgeon, and attained the rank of lieutenant-colonel. He received the Lyell medal from the Geological Society of London in 1917.

THE death, at the age of seventy-eight, of MR. JAMES KENNEDY is a serious loss to Oriental studies. The son of an Indian missionary, Mr. Kennedy was employed in the Civil Service of India from 1863 to 1900. After his retirement he was a leading figure in the Royal Asiatic Society, serving as treasurer until illness compelled his resignation, and winning the respect of his colleagues by his learning, business capacity, and kindliness of nature. He was one of those patient workers who are always collecting materials, hoping for new light on difficult problems, and thus he failed to accomplish his projected task, a history of the relations of Indian culture with those of Nearer Asia. He contributed to the Proceedings of the Royal Asiatic Society several valuable monographs, the most important being devoted to the early trade intercourse of Babylonia with India, the cults of Krishnâ, and the Aryans, the last published only a few months before his death. Though some of his ingenious speculations failed to meet with general acceptance, it is much to be regretted that he failed to accomplish the work to which his life was devoted.

LAST week there died in Paris, in his eighty-second year, M. ADOLPHE CARNOT, a member of the Academy of Sciences and of the Legion of Honour. M. Carnot was the grandson of M. Lazare Carnot and the son of M. Hippolyte Carnot, the Minister of Public Instruction in the Provisional Government of 1848. President Sadi Carnot was his elder brother. For many years M. A. Carnot held a professorship at the Ecole Supérieure des Mines, and was afterwards its honorary director. He was also Inspector-General of Mines in France.

M. Carnot's scientific reputation rests chiefly on his contributions to analytical methods, and his treatise on the analysis of mineral substances is the standard French work on this subject. It comprises a detailed account of the occurrence, properties, reactions, methods of separation, and analysis of all the metals, including the rare metals, which are very fully described. The information given with reference to the rare metals is based largely on his own original work. He was a frequent contributor to the *Annales des Mines*, and published papers on methods of determining phosphorus, silicon, potassium, iodine, chlorine, bromine, vanadium, molybdenum, chromium, etc. In 1900 there appeared his important joint paper with Goutal on the verification of compounds existing in iron and steel by using reagents with which to dissolve out certain of the constituents. This paper is one of the best that have appeared on this subject.

WE regret to have to record the death of MR. HAMMERSLEY HEENAN, which took place on June 17. Mr. Heenan was born in 1847, and had been a member of the Institution of Mechanical Engineers since 1875, and of the Institution of Civil Engineers since 1876. An account of his career appears in *Engineering* for June 25. At seventeen years of age he went to India and spent about fifteen years in the Public Works Department. Mr. Heenan returned to England in 1880 and founded the firm of Heenan and Froude, Ltd., of which he was chairman and managing director until his retirement two years ago. The firm is principally engaged on bridges and structural work generally. Among its undertakings is the Blackpool Tower. During the war Mr. Heenan rendered great service both in his personal capacity and in applying the resources of his works to the manufacture of munitions.

THE death is announced of DR. J. H. HYSLOP, the founder of the American Society of Psychical Research.

Notes.

THE report of the Advisory Committee on Civil Aviation (Cmd. 770, price 2*d*.), dealing with the question of Government assistance for the development of civil aviation, will be read with interest by those who are concerned in the commercial future of the aeroplane. The report considers at length the present position of civil aviation and the results which have been achieved, and reaches the conclusion that as regards both the progress of commercial flying and the maintenance of a healthy aeronautical industry the indirect assistance given in the past is insufficient. Definite proposals for direct assistance are made. It is suggested that such assistance should be limited to a sum of 250,000*l*. within the two financial years 1920–22, and calculated on a basis of 25 per cent. of the total revenue of the aviation companies concerned, without differentiation as to the nature of the load carried by the machines. "Approved" routes are suggested: (*a*) London to Paris, with extensions; (*b*) London to Brussels, with extensions; and (*c*) a route such as England to Scandinavia, giving opportunities for the development of seaplane and "amphibious" machines. Air-Marshal Sir Hugh M. Trenchard criticises this policy in a minority report. He considers that the Committee is not justified in its assertion that commercial aviation has hitherto been a failure, and expresses the view that there has not yet been sufficient time for the advantages of aerial transport to be appreciated widely and so to create the necessary demand. He further considers the policy of subsidies to be fundamentally unsound, and thinks the money would be better spent in encouraging the design of experimental machines and in helping forward general research on aeronautical questions—a view for which there is much to be said. Assuming the subsidy to be granted, however, Sir Hugh agrees with the mode of application suggested by the majority report.

THERE has just appeared the second interim report of the Water Power Resources Committee, which gives effect to the extended terms of reference it received in October last, viz. to take into consideration the steps necessary to ensure that the water resources of the country are properly conserved and fully and systematically used for all purposes. The Committee recommends that there should be established, by Act of Parliament, a controlling Water Commission, having jurisdiction over England and Wales, upon which should be conferred certain statutory powers and duties relative, *inter alia*, to the compilation of proper records of the water resources and water requirements of the country, the allocation of these resources, the adjustment of existing anomalies and hardships, and the reconciliation of conflicting interests. Such a body would assist Government Departments concerned in the uses and control of water, would advise Parliamentary Committees before which Water or Water Power Bills may be heard, and generally would act as consultants and technical specialists to the Government in regard to questions within their purview. They would also promote and initiate legislation for securing the development of rivers as a whole from source to mouth. The Committee recommends that further powers should be conferred on the Ministry of Health and other Government Departments to make orders authorising uncontested schemes of improvement. As regards its primary investigation, the Committee reports that there are several parts of Great Britain in which exist large sources of water power capable of development, but that it will deal more fully with this section of its inquiry in its final report, as well as with amendments required in the law in regard to pollution, underground water, and kindred subjects.

THE Department of Overseas Trade, in promoting the Empire Timber Exhibition at the Holland Park Skating Rink (July 5 to 17), has aimed at bringing under the notice of the British timber trade the various kinds of timber grown within the Empire. The exhibition will be fully representative of the timber-growing countries of the Empire, and should be of much interest and value.

THE annual meeting of the Somersetshire Archæological and Natural History Society will take place on July 20–22, and an interesting programme has been arranged. On the opening day, at Bridgwater, the new president, Mr. A. H. Thompson, will deliver an address on "Medieval Building Documents, and What We Learn from Them." In the evening of the same day Mr. A. F. Major will read a paper entitled "The Geography of the Lower Parrett in Early Times and the Position of Cruca." On July 21 a lecture will be given by Mr. H. Corder on "Rambles round Bridgwater." In addition, there will be many excursions to places of interest. Further particulars of the meeting can be obtained from Mr. H. St. George Gray, Taunton Castle, Taunton.

THE DUKE OF CONNAUGHT on Thursday last paid a visit to the Royal College of Surgeons of England and received the diploma of an honorary fellow of the college.

THE RIGHT HON. H. A. L. FISHER and Sir James G. Frazer have been elected fellows of the Royal Society, under the statute governing special elections, on the grounds of their having "rendered conspicuous service to the cause of science."

AT the meeting of the Royal Society of Edinburgh on Monday, June 21, the following were elected foreign honorary fellows:—William Wallace Campbell, director of the Lick Observatory; Yves Delage, professor of zoology, Faculty of Sciences, Paris; Hendrik Anton Lorentz, professor of physics, Leyden University; Alfred Gabriel Nathorst, Stockholm; Ch. Emile Picard, perpetual secretary, Academy of Sciences, Paris; Charles Richet, professor of physiology, Faculty of Medicine, Paris; and Georg Ossian Sars, formerly professor of zoology, Christiania, and Director of Norwegian Fisheries.

MEDALS have been awarded to the following by the Council of the Royal Society of Arts for papers read before the society during the past session:—J. W.

Pearson, "The Seed Crushing Industry"; S. Preston, "English Canals and Inland Waterways"; Sir J. Currie, "Industrial Training"; Air-Commodore E. Maitland, "The Commercial Future of Airships"; Sir W. S. Meyer, "The Indian Currency System and its Developments"; A. Howard, "The Improvement of Crop Production in India"; Sir F. Watts, "Tropical Departments of Agriculture, with Special Reference to the West Indies"; and Sir J. Cadman, "The Oil Resources of the British Empire."

THE Riberi prize of the Academy of Medicine of Turin has been awarded to Dr. G. Vanghetti for his researches on amputations and kinematic prostheses.

MAJOR KENELM EDGCUMBE has been elected chairman of the National Illumination Committee of Great Britain in succession to Mr. A. P. Trotter. A meeting of the International Illumination Committee is to be held in Paris next year to discuss technical subjects.

A MONUMENT to Wilbur Wright is to be dedicated on July 18 at Le Mans, France, near which town he carried out many of his aeronautical experiments.

THE annual meeting of the Research Defence Society was held on June 23, when an admirable address was given by Col. McCarrison on "Vitamines in their Relation to Health." Col. McCarrison spoke with authority; he made clear the facts already proved, and the intricacies of the study of vitamines. It is strange now to recall the old teaching about the "constituents" of our food; the proteins and the fats and the starches; the old South Kensington exhibits of an apple or a mutton-chop analysed down to half a dozen phials of chemicals, of water, and of "ash"; but not a word said of these potent and subtle vitamines which "animate the whole" and safeguard us against rickets and scurvy and beri-beri and epidemic dropsy. After the meeting Dr. and Mrs. Mellanby showed specimens of the results which they have obtained in this field of research, especially in the relation of vitamines to the growth of the bones and to the development of the teeth. The society's annual report speaks of increased activity in good educational work. The Jenner Society has become affiliated to the Research Defence Society, and this is a move in the right direction. The Research Defence Society has lately published an address by Sir Walter Fletcher on the work of the Medical Research Council, and is about to publish an essay by Sir David Bruce on tetanus and the use of tetanus antitoxin.

SIR CHARLES TOMES has presented to the museum of the Royal College of Surgeons of England the entire collection of microscopical preparations made by himself and also by his father, the late Sir John Tomes, during their investigations into the structure and comparative anatomy of the teeth. In this important donation are included the preparations—many of great beauty as well as of scientific worth—on which memoirs published in the Philosophical Transactions and Transactions of the Odontological Society were based. The gift thus made is to be known as the Tomes Collection, and will be accessible to all who are making a study of the comparative anatomy and microscopical structure of the teeth of vertebrate animals.

AMONG the worked flints collected from the ploughed fields of Norfolk and Suffolk Miss Nina F. Layard has lately observed several with well-defined finger-grips, which she describes in the latest part of the Proceedings of the Suffolk Institute of Archæology (vol. xvii., part i.). The implements are beautifully illustrated by photographs, showing how they are adapted by chipping for holding in the hand. They include both scrapers and borers, and one seems to be suitable for cutting hides. The age of the implements is undetermined, and Miss Layard compares them with certain scrapers obtained by the late Dr. Sturge from Luxor, Egypt. She also points out that the North Alaskan Eskimos at the present day carve finger-grips in the wooden or bone handles in which they fix their stone scrapers.

THE problem how to make philology interesting has been solved by Sir George Grierson in two papers on the Indo-Aryan vernaculars reprinted from the Bulletin of the School of Oriental Studies. The Aryan languages cover, roughly speaking, the whole of the northern plain of India, penetrating in the case of the Pahári dialects into the lower ranges of the Himalayas, while closely related to them is another group of tongues in the mountainous country lying south of the Hindu-Kush, which are here styled the Dardic or modern Pisácha languages. The most important result of the Philological Survey is that the Indo-Aryan vernaculars fall into three groups: the midland, occupying the centre of the great northern plain; the outer in a band on the west, south, and east; while between these lies the intermediate group representing the former shading into the latter. These groups of tongues are obviously the result of successive invasions or the peaceful introduction of foreign cultures. The pressing problem at present is how to combine the philological with the ethnological evidence, and Sir G. Grierson's papers are a valuable contribution to the solution of it.

MR. W. E. HEITLAND published in the *Journal of Roman Studies* (vol. viii., part i.) an elaborate, fully documented article on the conditions of agriculture in Italy in Imperial times. He specially deals with the question whether Italy furnished a large number of farmer emigrants to raise and maintain provincial agriculture. He finds that the evidence does not favour such an emigration. One of the most pressing anxieties of the Emperors was to maintain a corn supply from Egypt and other African regions. But for the development of this industry native African farmers would be best qualified. Therefore, while we are entitled to assume that the Emperors were anxious to protect their *coloni* from the oppression of dealers with the connivance of corrupt officials, we ought not to base far-reaching theories of State-assisted emigration on the occurrence of a few Italian names in provincial inscriptions, the authors of which may not have been themselves *coloni*.

INFLUENZA was persistent this year in London for seventeen weeks from February 7 to May 29, the deaths from the disease, according to the returns of the Registrar-General, numbering 20 or more each week. For the previous fifteen weeks, from

October 15, 1919, to January 31, the deaths in London had ranged irregularly from 12 to 24. The return for the week ending June 12 gives only 13 deaths in London due to the disease, and in the preceding week the deaths were only 19. For the seventeen weeks ending May 29 the average deaths per week numbered 59, and in ten previous epidemics out of a total of twenty-eight since 1890 this number was exceeded, the highest weekly average being 500 in the epidemic of 1918–19, which lasted thirty-one weeks; the next highest was 171 in the epidemic of 1891, and 162 in 1892. The maximum number of deaths in a single week in the recent epidemic was 861, whilst in that of 1918–19 the number was 2458, the next highest maximum being 506 in 1892 and 473 in 1895. Of the twenty-eight epidemics since 1890 only two have embraced the summer months, those occurring in 1891 and 1918. The age incidence of the last three epidemics has differed widely from all others inasmuch as the active and able-bodied, aged between twenty and forty-five, have suffered most severely, although the attack, which has apparently now abated, was less marked in this respect than the two epidemics of 1918 and 1918–19.

Medical Science: Abstracts and Reviews for June (vol. ii., No. 3) contains among its articles a review of the subject of tuberculosis, particularly in connection with the war. Tuberculosis only slightly increased in France and England during the war, and mainly among young women in industry, whereas, in Belgium, Germany, and Austria, all classes of the community suffered and to a rapidly increasing extent. The principal causative factor for this difference appeared to be that of food.

In recent years the development of genetics has been marked by the establishing in various countries of a number of new scientific journals dealing with this rapidly growing subject. The latest addition to this list is *Hereditas*, the first number of which we have just received. It is issued by the Mendelian Society of Lund, Sweden, the president of which, Prof. H. Nilsson-Ehle, is well known for his breeding experiments with wheat. The journal will appear three times annually so far as possible, making a volume containing about 350 pages. The contributions are to be published in English, German, or French, and the subscription is 25 Swedish crowns per volume. The first number includes a study of the resistance of wheat to the nematode Heterodera and its inheritance, by Nilsson-Ehle; the hereditary transmission of deaf-mutism, by Lundborg, and of hereditary tremor, by E. Bergman; the rate of pollen-tube growth in Œnothera and its possible effect on inheritance-ratios, by Heribert-Nilsson, as well as studies of colour inheritance in peas and poppies, chlorophyll factors in the onion, and bud-sports in wheat. The new journal, which thus includes in its range the study of human as well as plant and animal material, will be a welcome channel of publication for the growing Scandinavian school of geneticists, and will take its place among the standard journals on this subject.

In the Reports of the South African Museum for 1918 and 1919 Dr. L. Péringuey records some new facts relating to the Strand-loopers. In a cave-shelter a slab-painting was found above the kitchen-midden material and beneath a stalactitic column. Skulls in the midden were filled with gypsum. The geological conditions indicate that these formations must have taken a long time to produce—a longer lapse than is usually accepted. "If we take into consideration the conclusions of Shrubsall, that Strand-looper skulls differ materially from the Hottentot or so-called Bush races, I am justified, I think," says Dr. Péringuey, "in claiming for the Strand-looper branch of the 'San' that occupied at one time the southern littoral of the former Cape Colony, not only a mode of culture more primitive than that retained by any living human race, but also a greater antiquity than for any other living African race." From the South-West Protectorate was obtained, and is figured in the Report, a rock-graving on which hoofs of animals and reduced representations of human feet had been produced by picking. Such gravings may, perhaps, denote places where the Bush people had found game. These are only a few of many interesting discoveries mentioned in these Reports.

The Smithsonian Institution has a custom, which we commend to the British Museum, of publishing each year an illustrated account of its explorations and field-work. The report for 1919, just to hand, contains narratives and illustrations that might well stir the enthusiasm of the American public and lead to donations for similar purposes. Where so much is of interest to astronomer, anthropologist, ethnographer, geologist, and zoologist, we should be hard put to it to make a selection did we not find some notes by Mr. C. M. Hoy on the extermination of the Australian native fauna, to which the attention of British naturalists should be directed. "The greatest agent working towards the extermination of the native animals is the fox; next come the cattle and sheep men, who distribute poison by the cartload in the effort to reduce the rabbits. This has also caused or helped to cause the extermination of some of the ground-inhabiting birds. Another great agent is the bush-fires which sweep over the country. These are often lit intentionally in order to clear out the undergrowth and thus increase the grass. . . . The country at Bulliac is a good example of what the cattleman will do in a few years' time in killing off and burning the timber, and the consequent destruction of animal life. . . . The extermination of the native mammals has apparently gone much farther than is generally thought. Many species that were plentiful only a few years ago are now almost, if not altogether, extinct. Diseases have also played a great part in the extermination. The native bear died in thousands from a disease which produced a great bony growth on their heads. A mysterious disease also spread through the ranks of the native cat, *Dasyurus viverrinus*; the domestic cat also played a great part in their extermination. Even adult specimens of Dasyurus were often dragged in by the family cat. . . . There are very few game laws in Australia, and no one gives any attention to the ones that are in order."

THE greater part of a skeleton of the giant extinct marsupial Nototherium has lately been found in Mowbray Swamp, Tasmania. The skull and the limb-bones of the left side are described as well preserved, and are especially important for comparison with the numerous scattered remains of the same animal discovered in the Pleistocene deposits of Australia. The skeleton of Nototherium is less satisfactorily known than that of the allied Diprotodon, of which many specimens were found in Lake Callabonna, South Australia, about twenty-five years ago.

WE have received a copy of vol. v. (1918–19) of the Journal and Proceedings of the Royal Society of Western Australia, from which we learn that this society makes steady progress in membership and in the value and importance of its publications. The papers deal mainly with Western Australian problems. Prof. W. G. Woolnough writes on the physiographic elements of the Swan coastal plain, adding several details that have been overlooked in more general accounts. An important historical paper is one by Mr. J. S. Battye on the early colonisation of Western Australia. Mr. W. A. Saw contributes a paper on town-planning in Australia. His paper is noticeable for a number of well-chosen illustrations showing good and bad planning in various Australian towns.

M. EMILE BELOT, whose artificial volcanoes were recently mentioned in NATURE, vol. civ., p. 575, has published a work on "L'Origine des formes de la Terre et des Planètes" (Paris: Gauthier-Villars, price 14.40 francs). While holding that the earth and the moon developed from a state of luminous vapour of nebular origin, the heat of this vapour not being due to mere contraction, he points out, on the analogy of novæ, that the intensely heated stage may have lasted only a few months, while other successive changes, such as those when rains of chlorides fell upon a warm surface, may have occurred during the first few years of terrestrial evolution. We cannot here quote the figures by which M. Belot argues that the first waters would condense in the primitive atmosphere, owing to its high pressure, at the temperature of 364°; it is sufficient to mention that, on similar numerical reasoning, he shortens the interval between the first rainfall (Antarctic) and the middle of the Carboniferous period to less than ten million years. The tectonics of the crust are discussed with the aid of simple but suggestive diagrams, and the frequent reversal of views now popular will certainly encourage thought.

AMONG the handsome series of Professional Papers issued by the U.S. Geological Survey in these years of turmoil we may note one by Mr. E. de K. Leffingwell (No. 109) on "The Canning River Region, Northern Alaska." Its description and illustrations of soil and vegetation above permanently frozen ground, or above a subsoil consisting almost entirely of ice, are of wide interest in lands in which such conditions once prevailed. The author uses the term "ground ice" for bodies of ice in frozen ground, which involves confusion with what has always been known as ground ice ("anchor ice" is preferred by Mr. Leffingwell) in rivers or in shallow seas. In most of the areas in which underground ice has been recorded, the downward limit of seasonal thawing is less than 7 ft., 3 ft. being the rule. The author shows, however, that this ice is a product of surface-thawing, water penetrating downwards and adding to the frozen masses at the present day. Underground ice will form wherever the mean annual temperature is some 4°–6° C. below freezing point. The author makes a strong case for his view that very large continuous ice-masses, with occasional inclusions of earth, like those of the New Siberian Islands, may arise from the growth year after year of ice-wedges originating from surface-cracks.

ON May 27 Mr. B. S. Gossling read an interesting paper on "The Development of Thermionic Valves for Naval Uses" to the Institution of Electrical Engineers. He gives first a history of the introduction of the thermionic valve into naval radio-telegraphy, laying stress on the use of Langmuir's formulæ for the value of the electron current as a guide to the numerical design of valves. To old-fashioned electricians the formulæ, which are numerous, are very uninviting. The physical dimensions on both sides of the equations appear to be quite different, and the continual introduction of the voltage to the power 1·5 is very puzzling. We think that the time has now come when the definitions of the fundamental quantities should be made more rigorous, and symbols should be used for the various quantities which show their physical dimensions. In the paper the successive stages of the approximations which were adopted in the calculation of the characteristics of valves are recorded. The final result shows that the observed behaviour of a high vacuum valve can to a first rough approximation be accounted for in terms of known physical laws. Many ingenious tests are described. The method adopted, for instance, for estimating the vacuum in a valve while still on the pump is to have a special vacuum tube attached to the apparatus and measure the width of the "cathode dark space." The paper gives a good idea of the immense amount of work done on the valve by physicists and engineers during the war. The variations of the thermionic properties of the valves which were so puzzling and annoying a few years ago have now been brought within bounds, and a rough standard specification for their production is given. Unfortunately, sufficient information to enable rigid life test clauses to be made is not yet available. It is a great step forward, however, that even a rough specification can be given.

BULLETIN No. 2 for 1920 of the Classe des Sciences of the Royal Academy of Belgium contains a communication from Messrs. J. E. Verschaffelt and R. Crombez on the anomalous dispersion of methyl-violet, fuchsine, and paranitrosodimethylaniline. The authors use the method of Soret, which Wood also adopted, which depends on the division of a glass trough with parallel surfaces into two parts by a glass partition extending from one corner to the opposite one. One of the prismatic troughs thus formed is filled with a solution of the material the dispersion of which is to be inves-

tigated, and the other with the solvent alone. Owing to the opposing action of the two prisms the dispersion of the solvent is thus eliminated, and the anomalous dispersion of the solute observed directly. By this means the authors have determined the indices of refraction of the materials as follows:—Methyl-violet for wave-length 6712, 2·52; 6497, 2·43; 4455, 1·23; and 4227, 1·45. For fuchsine 6712, 2·21; 6497, 2·41; 6170, 2·63; 5857, 2·78; and 4227, 1·19. For para-nitrosodimethylaniline 6497, 1·74; 6170, 1·78; 5857, 1·81; 5603, 1·85; and 5270, 1·93.

IN the course of an article in *Engineering* for June 18 on the Birkenhead shipyard and works of Messrs. Cammell Laird and Co., Ltd., reference is made to the original generating stations which supplied the whole of the power for the works. The original station was equipped entirely with gas engines supplied from a Mond plant, which also supplied gas to the furnaces in the platers' and other shops. The ten gas engines were of varying sizes, and had a total capacity of 2500 kw. This gas station has done good service, but the large number of comparatively small gas-driven units has resulted in a considerable maintenance charge. There has also been difficulty at times during the war in obtaining suitable fuel for the producers. These conditions, combined with a growing demand for power, have resulted in a decision to shut the gas station down altogether, and to transfer all power generation to the new turbine station. The matter is of some interest in view of the controversy on fuel economy, and illustrates the fact that there are points other than mere economy of fuel to be taken into consideration by large power-users.

WE are asked to state that the Research Association of British Rubber and Tyre Manufacturers has secured laboratory accommodation in the Chemistry Department of University College, Gower Street, W.C.1.

WE regret to learn from an inset announcement in the current issue of the *Scottish Naturalist* that, notwithstanding that all editorial work in connection with the journal is rendered gratuitously, there was a loss on the year's working, which, however, has been generously met, and that in consequence of the continued increasing cost of production there is a possibility of the magazine ceasing to exist. We trust that this contingency will be averted, for our contemporary has performed valuable services to Scottish natural history for the lengthy period of fifty years. A largely increased subscription list would probably save the situation, and the publishers, Messrs. Oliver and Boyd, Edinburgh, will be glad to have the names of all who will help in the way suggested to keep in circulation this useful scientific periodical.

THE latest catalogue (No. 188) of Messrs. W. Heffer and Sons, Ltd., Cambridge, gives particulars of upwards of 1900 second-hand books ranging over a number of subjects. There are sections devoted to science and mathematics; folk-lore and mythology; archæology; India; Ceylon; China, Japan, and the Far East; Turkey, etc. The catalogue, which will be sent free upon request, is worthy of perusal.

Our Astronomical Column.

TEMPEL'S SECOND PERIODIC COMET.—The only additional information that has come to hand about this comet is that it was of magnitude 11 at the end of May. It should be of magnitude 9 or 10 in July, and therefore visible in moderate instruments. Accurate observations of position are badly needed, as very few were obtained at the last apparition in 1915. The period of this comet ($5\frac{1}{4}$ years) is the shortest known except that of Encke. Observations were secured in 1873, 1878, 1894, 1899, 1904, 1915, and 1920. The following approximate ephemeris is for Greenwich midnight:

		R.A.	S. Decl.	Log r	Log Δ
		h. m. s.	° ′		
July 6	...	23 14 51	7 17	0·1216	9·6962
14	...	23 39 41	8 59	0·1216	9·6791
22	...	0 2 40	11 5	0·1236	9·6685
30	...	0 22 24	13 27	0·1274	9·6636
Aug. 7	...	0 38 50	16 1	0·1330	9·6650

DENNING'S COMET OF 1881 AND A METEORIC SHOWER.—The Rev. M. Davidson has recently made some interesting computations of the dates and radiant points of certain comets if they originate meteor showers. Among these, Denning's comet of 1881 indicates a radiant on August 4 at 303°−10° about 3° N. of α Capricorni. For many years a prominent shower of slow, bright meteors has been visible from this point at the end of July and the early part of August, and it is quite possibly connected with the comet named. It was well seen in 1900 and 1902, as well as in 1908 and 1916. The comet probably returned in 1899, 1907, and 1916, though it escaped observation, and the next return should occur in 1925 if the computed period of about $8\frac{3}{4}$ years is correct. There are, however, meteors every year from this shower in Capricornus, and it should be specially looked for during the period from July 25 to August 8.

CAPTURE ORBITS.—Text-books on astronomy frequently contain a good deal of speculation on the possibility of capture of comets and satellites; we may quote as instances the Leonid meteors, supposed to have been diverted by Uranus from a quasi-parabolic orbit into an ellipse of short period, and the numerous comets of the Jovian family, on which Jupiter is presumed to have exerted a similar influence. In these cases the perturbing planet made the capture, not for itself, but for the sun. Capture of the former sort, in which the planet retains the captured body as a satellite, can apparently take place only with the aid of a resisting medium, in which case we must date the event in remote ages.

Little research of an accurate numerical character has hitherto been carried out on the subject. Prof. L. Becker contributes two papers to *M.N.* (vol. lxxx., No. 6), in which he shows that a star approaching a binary system may in certain cases suffer capture, while one of the original pair may be expelled from the system. He then points out that approaches would be more frequent in the direction of relative motion of the two star-streams, and by analysis of the distribution of the major axes of the orbits of binaries obtains a result in fair conformity with the theory. The research is made more difficult by the fact that there are two possible positions of the plane of a binary orbit. In a few cases (notably in the systems of Sirius and α Centauri) the spectroscope has decided which of these positions is the correct one. There are probably several other systems in which the spectroscope is capable of giving a decision. Observations of this kind are very desirable wherever they are possible

Education in the New Era.

IN addresses given in Leeds last February Mr. F. W. Sanderson, headmaster of Oundle School, very boldly faces the root of the evil in existing educational systems as it is felt in the school, and advocates radical reconstruction upon new lines. His view is that schools should be altruistic in their aims and methods and be based on service and co-operation rather than on competition. They exist solely to aid and enrich the life of the people. Traditional methods based upon public-school models accentuate the anti-social spirit of competition and damp down co-operation, whereas the schools of the country ought to be the source from which the transfiguring and transforming spirit of the age is breathed through the thoughts of men. A school is a microcosm, and its subject-matter is to be found, not in books, but in the world around it, of which it itself should be an idealised model upon a small scale. It should concern itself with the tragedies of undeveloped talent, the slow decay of the faculties of masses of men caused by their employment in industry, and the sullen mental stupor that, after the violent revolutionary period of youth, brings peace on an animal level. For the schools are concerned with similar problems. The elevation of the submerged, the bringing back into the stream of school-life of the weak, and the raising of the general average are even more important there than the provision of the fullest opportunity for talent and ability. So is it in the national life. We are presented with a vision of spacious halls and galleries, workshops, laboratories, gardens and fields, art-rooms, libraries, and museums for children to learn in instead of in stuffy class-rooms, by doing, making, inquiring, and co-operating rather than by the preparation for interminable examinations, which suit better those of the possessive and dominating order, of whom the world is growing so tired.

The policy of leaving dull, bread-winning drudgery unredeemed in the state it is, and concentrating upon the cultivation of the artistic and literary faculties of the workers in enlarged periods of leisure, can only have the effect of making the real work even more impossible. In spite of the cold douche of authority, we are told; in spite of the attitude of labour-leaders, once bit twice shy; and in spite of the enthusiasm ever seeking a new rallying ground for lost causes, workers, when they are left to themselves to plan their own scheme of salvation, choose for their education vocational and technical work. The average man glories in his daily work and trade so long as his heart is kept in it by his being treated as a human being rather than as a machine. In the spirit of craftsmanship, better than in medieval and drawing-room studies, is to be found the remedy for the evils of industrialism.

Science, the gift of the age, notwithstanding its repercussion upon the foundations of society, has not yet penetrated appreciably into our institutions of governance and education. It is the bed-rock upon which all future educational ideals must be based, and the new creative spirit it has reincarnated in the world—its spirit of inquiry for the love of truth for its own sake and its spirit of co-operation with others engaged in the same work—is that by which the age must outgrow the nightmare which the old spirit has made of it and the world. Scientific thought and research must be applied to creating new wine-skins rather than more new wine until this is put right. It has demolished the cobwebs of traditional economics and finance and substituted for them fundamental conceptions of the laws by which men live and move and have their being. It meets no opposition, and scarcely even discussion, now from the professional exponents of the merits of the existing *régime*. Were it not for private interests and the ignorance of its ruling classes science would not have any difficulty in restarting the world on saner lines.

What is especially remarkable about this is that it is no vision of a dreamer, "sicklied o'er with the pale cast of thought," but rather that of a practical public-school headmaster, who has burst open the prison-doors of the pedagogic strongholds of the past and reclaimed for the schools the right and duty of serving and studying their own age. If there were ten such men, haply they might yet be in time.

This picture from a schoolmaster of what could be done in the school opens out broader visions of what universities might accomplish. They are in the most extraordinary case. They can claim that they have given in the research ideal of science—the finding out of the fundamentally new, *not* the mere rediscovery of the old that has been lost—the creative agency by which alone the modern world is great or even distinguished. But it has been done in the teeth of official apathy and discouragement. On the other side of the balance sheet is the traditional education they continue to give to the ruling classes, training them to be impervious to new knowledge and able only to find in the old and dead past ideals for imitation and reverence. These ideals and maxims have set the producers of wealth of the modern world at one another's throats for the benefit of its wasters. The code of laws remains as in olden time, though its obvious result has been to turn to debt the increase in the wealth of the community which the labours of scientific investigators have made possible. The world despises such results and wants something more from its old universities than that they should be beggars for their existence for crumbs from the tables that its own schools of science have loaded with gifts. It looks to them for a clear enunciation of the first right of the community to the produce of its own labours, which the law allows by taxation, for the upbringing of its own youth and for the cultivation of its creative institutions where knowledge is made and disseminated. The claim of the usurer upon that produce is secondary both by law and by common sense. And, lest again the stability of the world be endangered by its rulers being educated on myth and verbal subtleties to the total exclusion of the laws that appertain equally to Nature and to life, let them in the spirit of Plato inscribe over their reformed portals:—

"Let no one enter who is destitute of science."

FREDERICK SODDY.

British Aeronautics.[1]

THE Report of the Advisory Committee for Aeronautics for the year 1918–19 is an interesting record of work achieved, which acquires additional interest by including a general review of progress made since the beginning of the war. More than ever, after reading it, one is impressed by the range and extent of the demands which this new industry has made upon existing knowledge; of the structural engineer it requires that its stress calculations and the testing of its materials shall be conducted with an accuracy never contemplated before; of the mechanical engineer, that its engines shall be economical both of material and of fuel to a degree which until very recently would have seemed almost

[1] "Aeronautics." Report of the Advisory Committee for Aeronautics for the Year 1918–19. Pp. 77. (London: H.M. Stationery Office, 1920.) Cmd. 488. Price 4*d*. net.

fantastic; and, above all, of its pilots, that with the skill and technique peculiar to their craft they shall combine a practical working knowledge of structure and of machinery, of instruments and "wireless," of meteorology and of navigation, which in other professions would be the province of different specialists. And this universality, as might be expected, is no less characteristic of the appeal which aeronautics has made to the man of science, who provides it with fresh data; so that it is not surprising to find that the single committee of pre-war days has been compelled to adopt a policy of devolution, and that special sub-committees have been formed to deal with problems of such different scope as "scale effect," the investigation of accidents, internal-combustion engines, light alloys, meteorology, atmospheric electricity, and new inventions.

The report abounds with indications of fields in which further research is needed, and there seems every reason to believe that this research will be prosecuted with equal success under the auspices of the newly constituted Aeronautical Research Committee. We learn with satisfaction that the demand for the earlier technical reports has been vigorous enough to justify the printing of a complete second edition, since an opportunity is thus given for inserting much more complete cross-references than were possible when they first appeared. It is, perhaps, a matter for some little regret that a more definite lead has not been given in this direction by the present report. We imagine that any reader whose interest in the subject extends to the detailed reports of the several sub-committees would wish to have such references to individual papers and their authors as will enable him to find additional information on any special point; moreover, an account so detailed, and yet empty of names and references, may fail to impress what we believe is the secret of British supremacy in aeronautics: that our official Committee has interpreted its functions as being advisory rather than executive, and has endeavoured to assist, co-ordinate, and encourage research rather than to originate and control it.

No useful end would be served, and perspective would be lost, by abstracting from these excellent and thoroughly condensed reports. Their range is very wide, extending from complete investigations, on both the practical and theoretical sides, of such complex evolutions as "spinning" to researches on the properties of light alloys, the transmission of heat from rough and smooth surfaces to passing currents of air, the conditions leading to discharge of atmospheric electricity from kite-balloons and cables, and the best shape for parachutes. Few, we believe, will read these pages without discovering some points of contact between aeronautical science and their own particular field of investigation.

Mention should be made of the very interesting table of comparative performances of British aircraft which is included as an appendix.

Climatic Cycles and Tree-growth.

PUBLICATION No. 289 of the Carnegie Institution of Washington is devoted to Prof. Douglass's study of the annual rings of trees in relation to climate and solar activity. When the late Prof. Lowell was seeking an ideal climate for his observatory, with the view of studying the planet Mars, he chose the dry region of Flagstaff, Arizona, on account of its low rainfall and high proportion of clear skies. While Prof. Douglass was at the Lowell Observatory it occurred to him that variations in solar activity might have a measurable effect on tree-growth, since the latter was probably dependent on rainfall, and rainfall might very likely be affected by solar activity. He began by studying the yellow pines of those arid regions, arguing that a very dry climate should be the best for such an investigation. He soon found that the intimacy of the connection between the width of the annual tree-rings and the rainfall, when the latter was known, was far closer than he had dared to hope, and he pushed further afield, examining tree specimens and fossils in European collections as well as in other districts of America.

Considerable labour was involved in the interpretation of the various appearances of the rings, the red tissue that denotes the close of a period of growth. The year starts in the autumn. With normal winter snow and spring and summer rainfall growth continues throughout until the autumn, and a ring of normal width is produced. If winter snow is deficient and spring rain also scanty, a narrow ring is produced, closing prematurely without waiting for summer rain. An intermediate condition is shown when winter snow is deficient and the spring drought is not so severe; red tissue begins to form, but growth starts again, and the result is a double ring for the year.

The author considers that five trees in a group give a trustworthy result in general, though in a very dry district like Arizona two might suffice. The only district where five trees failed to give a satisfactory cross-identification was a rugged region near Christiania, in Norway.

The Flagstaff record is complete from A.D. 1385, but among the sequoias of California stumps are in existence dating back more than three thousand years. Some of these sequoias grew on hillside slopes, and others in basins where plenty of moisture is found at all times. The latter are unsuitable for investigation, and the author calls them "complacent," as they show practically no variation in the annual growth. The others he calls "sensitive," as they have to depend upon snow melting down the slope and upon rain as it comes, not being provided with any storage such as that found in the basins. Some specimens, including the oldest of all, showed signs of a change in environment, "complacent" in later growth but "sensitive" earlier. Prof. Huntington had previously investigated these sequoias in his search for evidence of climatic change, but his purpose was served with much less detailed measurements, ten-year periods being short enough for his unit of time. His dates agree fairly well with those of the present work. The analysis of the data for periodicities required considerable accuracy in the method employed, and ultimately led to the adoption of the "automatic optical periodograph," of the construction and application of which full details are given.

Practically all the groups of trees investigated show the sun-spot cycle or its multiples; the solar cycle becomes more certain and accurate as the area of homogeneous region increases or the time of a tree record extends farther back; this suggests the possibility of determining the climatic and vegetational reaction to the solar cycle in different parts of the world. A most suggestive correlation exists in the dates of maxima and minima found in tree-growth, rainfall, temperature, and solar phenomena, pointing to a physical connection between solar activity and terrestrial weather. There is a very important point discussed under the title of "Meteorological Districts." It is essential to restrict any such district for this purpose to one in which homogeneous weather conditions are found. Clearly, if one set of conditions makes one district wet and a neighbouring district

dry, these cannot be lumped together for correlation purposes, as the whole effect will be masked. We are reminded of the sun-spot maximum of 1893, which was associated with great heat in England and France, but was exceptionally cold in America and other parts of the world. This limitation of districts may not, as the author recognises, be the same for short periods as for long ones, but he finds the major characteristics in mountain regions very much alike over distances of fifty or sixty miles, and relies upon the evidence of the trees themselves for the demarcation of the districts.

One other small difficulty Prof. Douglass has met in an ingenious manner. It is often noticed that such an element as rainfall, when expressed as departure from the mean, as it must be in correlation problems, is arithmetically lacking in symmetry, since the defect can only be 100 per cent. at most, while excess can be very much larger. Geometrically, this can be avoided by using a logarithmic scale, but this flattens the variation very much. Prof. Douglass's device is to leave the deficient amounts unaltered, but in the case of excessive falls to invert the fraction and measure upwards from the normal. Thus a rainfall of twice the normal is indicated by a point just so far above the normal line as the point indicating a rainfall of half the normal is below it. The symmetry is not perfect, as, of course, no possible wetness can give a point corresponding to zero rainfall, but the method is convenient in places where zero rainfall in the unit period is unknown. W. W. B.

The Interferometer in Physical Measurements.[1]

A FOURTH volume describing the researches of Prof. Carl Barus with interferometers has recently been issued. The classical work of Fizeau, who applied interference methods to the determination of expansion coefficients, directed attention many years ago to the possibility of the kind of work which has been so well developed by Michelson and others, and in the present series of papers Prof. Barus seeks to develop the methods of application of the interferometer to a somewhat wide range of physical measurements. These include spherometer measurements, elastic deformation of small bodies, elongations due to magnetisation, pressure variation of specific heat of liquids, and even electrodynamometry. The remainder of the volume deals with various modifications of the interferometer methods and with certain gravitational experiments.

Doubtless such an investigation of methods will be useful to workers in any of the foregoing fields, but so far as a first impression is to be trusted it would appear that the main interest has lain in the *method* rather than in any results which have been attained.

In order to study the motion of a contact lever, it may be made to carry two small mirrors reflecting normally two beams which are afterwards caused to interfere. Any rotation of the lever obviously causes a difference of path, which appears in the shifting of the easily recognisable and distinctive central "achromatic" interferometer fringes, such motion being measured by a plate micrometer or "graticule" in the observing telescope.

The two mirrors form the limbs of a "T" piece, which is pivoted about a hinge at the end of the foot. One limb ends in a contact pin which abuts against the surface, the motion of which is to be measured.

In such circumstances Prof. Barus estimates the limiting sensitiveness to be 33×10^{-6} cm., or perhaps even a third of this amount, but it should not be forgotten that the very simple interferometer system of an optical test-plate has a sensitiveness of about a quarter wave-length, say 12×10^{-6} cm., and this without a doubtful hinge and another contact. The contact lever can, of course, deal with non-specular surfaces, but to use it as a spherometer for a glass lens seems quite needless. Naturally, an apparatus of this nature is excellently adapted to such a problem as that of investigating the changes of length of a magnetised rod, and, although no very novel results are obtained, the investigation has been comparatively easy, and the method is well adapted for demonstration.

Suitable self-adjusting interferometers, such as are described in chap. vii., ought to find an increasingly useful place in the physical laboratory, and students should be taught the practical use of such instruments and their modifications. There is too great a tendency to treat an interferometer as a piece of apparatus sacred to one or two highly specialised purposes, but with little more than a few pieces of good plane parallel glass a set of instruments can be made up which should be of the greatest use in teaching and research.

One could wish, perhaps, that some one problem had been attacked and solved thoroughly. The curiously unfinished nature of the work is disappointing, but we must conclude that the method is the chief object. As regards the text, the descriptions are clear and praiseworthy, but the diagrams are both inadequate and unsatisfactory. L. C. M.

[1] "Displacement Interferometry by the Aid of the Achromatic Fringes." Part iv. By Prof. Carl Barus. (Carnegie Institution of Washington, 1919.)

Canvas-destroying Fungi.

WHEN men again began to take to their tents at the outbreak of war, many noticed that dark brown and black spots, frequently of a diamond shape, were not uncommon on the canvas. Small, surreptitiously acquired bits began to be scattered around for information as to the identity of the moulds causing the rot. Now it is very surprising that so little work has been done on canvas-destroying fungi. That canvas is liable to suffer from moulding seems generally to be known, judging from the fact that any material likely to get wetted is usually "cutched." Shortly before the war aircraft workers began to interest themselves in the fungi concerned in the damage, but it was not until war broke out that one realised the extent of the destruction of sails, tents, etc., by these organisms.

Major W. Broughton-Alcock, in the Journal of the Royal Army Medical Corps for December last, gives a short account of investigations carried out by him in Malta, Italy, and (in conjunction with Miss A. Lorrain Smith) at the Natural History Museum. In Malta attention was soon attracted to the rapid spotting and destruction of tentage—awnings last there only about a year. The investigators found that the principal agents of destruction of cotton- and flax-made canvas are Macrosporium and Stemphylium. The latter is the more prevalent in Malta, and could be isolated by exposing culture plates to the air. The colours of the spots on canvas correspond to the colours seen in cultures, being first brown and then black. The variation in the colour of the spots, especially noticed in flax-made and more resistant canvas, was found to be due to other fungi in association with the above genera—Septoria, Alternaria, Helminthosporium, Chætomium, Exosporium, Penicillium, Oospora, Torula, Saccharomyces, and yellow pigment-forming and other air-borne bacteria. Though

these fungi may assist in the destruction, no proof was obtained that this took place without the presence of Macrosporium and Stemphylium. The fungi grew well on Sabouraud's medium and on ordinary agar.

According to the author, the first signs of fungoid growth appear on the inner side of the roof portions of tents and marquees. Often within three months pressure on the spots made by the fungi leads to perforation, or a strong wind causes tearing.

Cotton and linen duck-canvases ready for tent-making were examined, but, though the flax fibres were in good condition, brown mycelium was found more or less in abundance. It is suggested that the fungi reach and begin growth during the retting of the flax, though they may be present on the growing plant. Mycelium was not found on new cotton-made canvas, and "this is not surprising when its method of preparation is studied." It is not, however, probable that the infection of linen canvas is restricted to the period of retting. Guéguen (NATURE, vol. xcix., 1917, p. 206) was of the opinion that fungi from the dead stems of the textile plant were introduced amongst the fibres. This might account for their absence from new cotton-made canvas, but there is little doubt that both linen and cotton canvas often become infected after having been made up.

Experiments showed that the Willesden (cuprammonium) method and cutch treatment prevented the growth of the fungi. A method suggested by Prof. Pinoy (soft soap 1 in 5000 solution, followed by a mixture of 1 per cent. of alum and $CuSO_4$) greatly inhibited the growth, and its extended employment in Malta gave very satisfactory results. Mango-treated canvas was in no way inhibitive.

No mention is made as to whether the "cutch" was the ordinary commercial cutch (product of Acacia, etc.) or whether it was sodium chromate, which was used in certain areas. In Salonika this was found the best preventive for "diamond spot" on comparison with Guéguen's and Pinoy's treatments, and was at the same time a satisfactory camouflage.

J. RAMSBOTTOM.

The Economic Pursuits of the Trobriand Islanders.

AT a meeting of the Royal Anthropological Institute held on Tuesday, June 1, Mr. S. H. Ray, vice-president, in the chair, Dr. B. Malinowski read a paper on "The Economic Pursuits of the Trobriand Islanders." In his opening remarks Dr. Malinowski criticised the methods usually followed by observers in dealing with the economics of primitive peoples. Whereas it was usually held that such peoples were preoccupied solely with obtaining an adequate individual food supply, he had found that, at any rate among the peoples which had come under his observation, there was a highly complex economic organisation. In support of his view he described the economic system of the natives of Kiriwina or the Trobriand Islands, lying to the north of easternmost New Guinea. These natives are very efficient and industrious tillers of the soil. Agricultural production is highly organised, being based upon two social forces: the power of the chief and the influence of magic. The chief is overlord of the garden-land, and initiates in each season the allotment of garden-plots to individuals and settles any disputes about garden-land; he finances any communal work to which the natives resort when clearing the bush, planting the yams, and bringing to the gardens the big, heavy poles used in connection with magical rites. On the other hand, the traditional garden magician controls the detailed proceedings of the work and performs magical rites at each stage.

There are several customary forms of communal work. An interesting institution of ceremonial enterprise, called *Kayasa*, is applied to gardening, fishing, oversea expeditions, and industrial activities, as well as to tribal sports, games, and dancing. Such a period of communal work is announced by the chief, who gives a big feast, which is followed during the continuation of the work by periodical distributions of food. Fishing, the building of houses and canoes, and other economic activities are based upon organisations similar to that of gardening. All are dependent upon the social power of the chief and the influence of the respective magician.

The distribution of the products is as highly organised as the production. The producer receives a certain portion, but a considerable part is used for the financing of big tribal enterprises through the chief, and another part is transformed into permanent wealth. By various tributes, dues, and offerings the chief collects about 30–50 per cent. of the tribal wealth, and he is the only member of the community who is allowed on a large scale to transform it into permanent wealth. This he does by keeping a number of industrial workers dependent on himself, who, for payment in food, produce polished "ceremonial" axe-blades, neck-strings of red shell discs, and arm-shells made of the conus shell, which are of very high value in the eyes of the natives, form the foundation of certain kinds of native trade, and are an indispensable feature of the social organisation of the natives. Every important transaction, whether ceremony or magical rite, birth, death, or marriage, has to be accompanied by gift and counter-gift. These are arranged, as a rule, so that while one party gives a substantial present of food, the other offers one of the tokens of native wealth, such as a ceremonial axe-blade, an arm-shell, or a string of shell discs. The powers of the chief are largely exercised through economic means. In inter-tribal affairs the chief backs up with gifts his summons to arms of his vassals, and the conclusion of peace after hostilities; and the same method of remuneration was followed when, in his narrower jurisdiction, direct punishment was meted out by ordering a special henchman to kill the offender or by calling upon a sorcerer to cast an evil spell on the victim. In both cases payment for the service was made in native tokens of wealth. These tokens of wealth have sometimes been designated by the term "money," but rather they represent stored-up wealth. Although a basketful of yams, a set of four coconuts, or a bundle of taro is, to a great extent, the common measure of value, there is no article among these peoples which, properly speaking, fulfils the function of a medium of exchange.

Two of these tokens of wealth, the arm-shells and the necklaces of shell beads, are used for a remarkable form of trade, called by the natives *Kula*, which embraces a ring of islands and archipelagoes lying to the east and north-east of British New Guinea, in which these two articles circulate in opposite directions. They are constantly being exchanged, scarcely ever being put to any use, but returning after a few years to the same district whence they were originally sent out, and then being traded again. The exchange is of a highly formal and ceremonial character, based on mythological tradition, and carried on according to very complex and rigid rules. Extensive and daring oversea expeditions in big sea-going canoes are made year after year, mainly in order to carry on this exchange. It involves a singular form of ownership, by which a token of wealth never remains in the hands of one man for any length of time. Instead of owning one article permanently, he owns a great number of articles temporarily. As a result of this

investigation it would appear that chieftainship, kinship, and social organisation in general are intimately bound up with the economic organisation.

In the discussion which followed the reading of the paper all the speakers emphasised the value and originality of the view of primitive culture which Dr. Malinowski had formulated in his interesting communication. Prof. Seligman asked how far the elaborate organisation of garden cultivation depended upon the existence of the chieftainship. Among the Southern Massim of New Guinea, for instance, there were no chiefs, and the native social organisation was based upon the hamlet. Had the elaborate garden organisation been observed among such peoples?

Sir James Frazer agreed that the economic aspect of primitive culture had not been adequately studied. It was interesting to note how the tribal economics were saturated with magic, and how the fallacy of magic still persisted among people who had developed a high system of agriculture. The mention of torches used by the magician in the ceremonies led him to compare the torches to which reference was made in the Greek legends of Demeter's search for Persephone. Was it possible that these torches represented a survival of a use of torches in early Greek agricultural ceremonies similar to that to which they were put in the Trobriands?

Mrs. Routledge suggested that an analogous complexity of economic organisation might be found among the people of East Africa with whom Mr. Routledge and herself had come into contact, where ivory played an important part.

Mr. Ray said that Dr. Malinowski had submitted a new view of ethnological investigation to the institute. Some of the ceremonies described by him suggested ceremonies from the other end of Melanesia, namely, Loyalty Island and New Caledonia, where the agricultural operations were directed by the chief, who prescribed what ground should be put under cultivation, the kind of crop, and the like, and received the first and best of the produce. Was it possible that these complex economic systems existed wherever there were chiefs whose position, power, and prerogatives depended upon the fact that they were of extraneous origin?

The lecturer in his reply stated that although garden magic was carried out by the Southern Massim at Dobu, cultivation was not accompanied by such a complex organisation for distribution.

The Organisation of Scientific Work in India.

THE Indian Industrial Commission during its tour through India found that all was not well with the scientific worker, especially in connection with the application of his work to industrial development. While stating specifically in its report that "we do not propose to deal with the general problems of pure scientific research," it adds: "We were impressed by the value of the work which had already been done in the organised laboratories, and by the absolutely unanimous opinion which was expressed by all scientific officers as to the inadequacy of the staffs in point of numbers. Everywhere we were brought face to face with unsolved problems, requiring scientific investigation on an extended scale. On the one side, we saw the results accomplished by enthusiastic scientists, which, regarded from the purely economic aspect of the question, have added enormously to the productive capacity of India; on the other side, we were told by forest officers, agriculturists and indigo planters, engineers, and manufacturers, of the limitations placed upon the development of their work and the frequency with which they were brought to a standstill by a lack of knowledge regarding matters which could only be ascertained by systematic research work." It is clear from these and other passages that the Industrial Commission desired to direct attention to the necessity for the elaboration of some scheme by which an organised attack might be made on the large number of problems awaiting solution in connection with the development of industry, and the conclusion reached is that "the maintenance of a staff of suitable technologists and scientific experts is essential to industrial development."

The Commission then gives its reasons for considering that it is the duty of the State to provide the necessary facilities, and concludes: "We have thus no hesitation in recommending a very substantial increase in the scientific and technical services as essential to industrial development." A general discussion follows as to the relative merits of a system in which the science is the bond, and one in which the bond is formed by the application of the sciences dealt with. In the first case the Geological Survey is given as an example, and the Agricultural and Forest Departments are quoted as examples of the second. But it is clear that the Commission was fully alive to the difference between a service and a department, and realised that the differentiation given above was the same as that between a service and a department, because it says: "The constitution of a certain number of scientific services based on the assumption that the science itself is a chief link between all members does not prevent the formation of departments, either Imperial or provincial, where the application of various sciences is the chief bond of union." The essential difference between the two types of organisation is clearly indicated in subjoined extracts from a despatch of the Government of India.

The Commission states that its proposals in the case of chemistry will have to be submitted to a special committee, and that it "hesitates to offer suggestions in greater detail regarding the organisation of the Imperial scientific services for bacteriology, botany, and zoology, as we consider that the best plan will be the appointment of special small committees for the purpose of formulating proposals." The first of these, that for chemistry, has now reported, and the report is open for discussion. As regards other sciences, it would be best to await the reports of the other committees before offering any remarks upon them.

The following extracts from the Government of India's dispatch dated June 4, 1910, place in a very clear light the intentions which underlie the recommendations of the Commission:—

The Scientific Services.

One of the main proposals refers to the constitution of scientific services and of an industrial service. The Commission direct attention to the extreme importance of research under modern industrial conditions, and to the especial needs of India, in view of her vast unexploited resources in raw material and of the paucity of her scientific workers. They criticise the complete lack of organisation among men of science employed by the Government, and describe the difficulties, both administrative and technical, to which this gives rise. The Commission recommend as a remedy the creation of a similar mechanism to that through which the Central and Local Governments have hitherto carried out almost all their most important activities, especially those requiring technical knowledge, viz. all-India services; and they discuss the basis on which these services should be con-

stituted. The Commission propose the creation, not of scientific departments, but of scientific services—an essential distinction which has been clearly brought out in the replies of Local Governments, though it has not been so clearly apprehended by critics of the proposal. The Commission contemplate the recruitment of officers into separate scientific services, such as a Chemical, Botanical, or Zoological Service, for employment under Imperial and provincial departments, such as Forests and Agriculture, which deal with the application of a number of separate sciences. They propose that scientific officers in the employ of the Government, instead of being recruited in small numbers or single units into the different services which happen to require them, should be recruited as experts in their several sciences into scientific services, each with its appropriate conditions of qualification, pay, pension, and promotion. Although the services will be distinct entities for the above purposes, yet the only members of those services that will not be actually employed under the various departments that require their services will consist of a central staff, engaged under such officers, for instance, as Deputy Chief Chemists, at research centres, in scientific work. This central agency will also serve as a reservoir to meet the demands that may be put forward by other departments or by Local Governments for men to undertake temporary special investigations, to fill new posts or leave vacancies, or for the replacement of existing officers.

The head of each scientific service would thus exercise an influence over the members of his service in matters scientific, by the check of scientific results, and by the provision of advice and criticism on scientific work, whether for Local Governments or for research workers. It is not, we understand, proposed by the Commission, nor do we ourselves contemplate, that he should actually control research work in the sense of ordering definite problems to be taken up by officers serving under Local Governments, or should turn his department into a gang of hack researchers. We rely on constant correspondence between scientific officers of the same caste and periodical conferences as sufficient to correlate research programmes.

Local Governments and heads of Departments find the greatest difficulty in forming an opinion of the work done by men of science employed under them, or of the probable value of lines of research proposed by their officers. Should the administrative authority consider the results obtained by a man of science unsatisfactory, it is almost impossible to obtain an authoritative opinion on his work or qualifications; or to say whether he might not do better in another post; or to find such a post for him. The difficulties arising from the existence of isolated specialists in a department are, in fact, notorious.

The impossibility of applying any common measure in determining the respective claims to promotion of a botanist, a chemist, an engineer, and a political economist has been recognised in the existing services by the creation of separate posts on a time-scale. But this does not get over the difficulties already indicated, or supply the proper incentive to the research worker, or afford scope or prospects for men of more than average ability. The absence of such prospects is bound to militate against our chances of obtaining good recruits, to render our staff discontented, and to prevent our securing the best work from the best men.

Moreover, so long as students of a particular science are recruited sporadically on behalf of different departments as vacancies occur, the Government will have to accept the men that happen to be left over, whatever their qualifications, after other and more regular demands have been supplied. The prospect of regular annual recruitment will enable the Government of India to fill its future demands for men of science, as it has hitherto done for engineers, forest officers, and medical men.

The present system, under which the only chemists employed by the State are scattered through numerous departments without any organisation that can marshal the chemical forces of the country to attack problems of national importance, can give no help towards an active industrial policy.

We might quote as illustrating the inspiring value of a central co-ordinating authority, the work undertaken by the Munitions Board through its chemical adviser. The report of the conference of chemists at Lahore shows that even our isolated and scattered chemists can be moulded into one team for the purpose of suggesting new lines of research and means for turning the results to practical account without overlapping and consequent waste of effort.

This experience, in the light of the magnificent results obtained in England by the Research Committee of the Privy Council, shows clearly how much may be expected from a system which provides a permanent organic connection between all chemists in Government employ.

The importance of a common system of recruitment and of a common service has recently been recognised by the council of the Institute of Chemistry in the United Kingdom (*vide* Proceedings of the Institute of Chemistry, 1918, part iv., p. 14) in a representation submitted by them to all Government Departments in which chemists are employed. They state their opinion that "the time is opportune for taking steps to secure for the provision of chemistry a position corresponding to that occupied by the learned professions, and they feel that much would be accomplished towards the attainment of that end if, in the first place, adequate and uniform conditions of appointment were accorded to chemists directly engaged in the service of the State. The necessity for a definitely organised chemical service (both in peace and war) for all purposes of the State on which the science of chemistry has a bearing has long been recognised in the chemical profession."

Conditions in India render the services of chemists employed under Government of even greater relative importance than in England. India is far more deficient than England in the knowledge of its raw materials and of the appropriate industrial processes; consulting chemists and chemists in private employ are almost entirely absent here, and this deficiency is not likely soon to be remedied. Research institutes with special reference to a particular industry in England, it would seem, will usually be financed and controlled by the industry itself, with a Government grant-in-aid, whereas in India the position will be precisely the opposite, and the industry will rely primarily on State chemists. We therefore agree with the Commission that the advancement of industries in India must depend for scientific assistance almost entirely on State-employed men, and these men will be far more concerned with the initiation of important new lines of development and research and far less with merely routine work than is the case in England. The need of organisation is the greater in that the functions of Indian State chemists are more important to the country; while their greater isolation and the consequent absence of a scientific atmosphere furnish an additional argument. The case for a State chemical service is thus even stronger in India than in England.

We are much influenced by the prospects which the proposed system affords of increasing the number of

Indians in the scientific services. An Indian appointed to an isolated post, or as an assistant to an isolated professor in a country where the scientific atmosphere is non-existent, or at the best exceedingly attenuated, lacks guidance and the stimulus of his fellows in the pursuit of scientific knowledge. His ambitions tend to become limited to the improvement of his pay and prospects rather than of his professional attainments. His membership of an all-India service, based on the pursuit of a common science, will increase the prestige of that science in his eyes and in those of the Indian public; the existence of the proposed Imperial nucleus of scientific workers under a distinguished chief will provide him with an incitement to excel with assistance in his studies and with opportunity for training if he desires it.

The Commission propose that, if the principle of scientific services is approved, committees should be appointed to formulate proposals for the permanent organisation and the terms of employment of each such service, and for the location and equipment of research laboratories. We support this recommendation, subject to the condition that the terms of reference to each committee should include a direction to report as to the advisability of constituting all-India services for each well-defined science.

Without anticipating the conclusions of the proposed committees, we think it desirable, in view of criticisms which have been expressed, to indicate certain principles in the general administration of these services which should govern the relations between the members of the scientific services and the heads of departments and provincial Governments, under whom many of them will be employed.

We do not think that members of scientific services should be seconded by the method which the Commission propose, viz. by deputation for periods of five years at a time; but we consider that (as in the case of other services) an officer, when once placed permanently under the orders of a local Government, should remain with the Government for the rest of his service, unless the Government under which he is serving itself desires his transfer, or unless his services are required in a higher post or in a post requiring special qualifications outside the province, in which case the local Government will recognise that the Imperial Government has a claim on them. This is the system which exists at present in respect of all similar services.

Local Governments would have complete liberty to appoint, after consulting the head of the service, to any post in their industrial or scientific cadre, any available member of the respective services; they would also be at liberty, in the special circumstances arising during the initial stages, to appoint to such posts men outside the service; but the subsequent admission to the all-India service of men so appointed would be entirely controlled by the Secretary of State. The local Governments universally support the proposed scheme of scientific services, and though the Governments of the Punjab, the United Provinces, and Bombay, and the officers and public bodies consulted by them, put forward certain criticisms of the scheme, especially with reference to the position of men of science in the Education Department, these criticisms are, we think, fully met by the foregoing explanation of the lines on which we think the proposed services should be administered.

We desire, however, to add a few remarks with special reference to the case of science teachers. We fully recognise that much is required of a scientific professor in a college, outside his scientific work. He must look on himself as a member of the body responsible for the tone of the college and for its general success. It will, therefore, we agree, be most undesirable that such a man should continuously have in mind the possibility of promotion outside his own department. We think, however, that this difficulty will be obviated by the general principle laid down by us above, viz. that members of scientific services serving under the Department of Education should not be removed from that Department, unless at the request of the educational authorities, or for posts requiring high administrative capacity, or special scientific qualifications.

The advantage to the Education Department of a system of scientific services will still be very considerable. In the first place, we consider that, though university and college science workers should be by no means entirely divorced from technical research, their main sphere of activity should lie among problems of pure science. The proposed central scientific organisation should afford a means whereby such problems arising in the course of technical research can be referred to university and college laboratories.

Such co-ordination, both in respect of pure science problems and technical problems, can be most readily effected in cases where the educational researchers are themselves members of a scientific service. This policy will doubtless stimulate the interest in research work taken by students and professors. Officers who have entered the educational service as teachers may be in some cases expected to develop as research workers. The existence of all-India scientific services will afford a ready means for accommodating men whose aims in life have thus been diverted from one form of work to another. In the next place, the present system of recruitment of men of science into the Educational Service is capable of improvement, and far better results could be obtained with the aid and advice of watchful central agencies in India. The absence of a scientific atmosphere, again, has been particularly injurious to scientific officers in the Educational Service, and has led to great stagnation in respect of research work. This atmosphere will in future reach individual officers by the numerous channels of communication which will be created between them and the central agency on technical subjects, whether by way of correspondence, conferences, and scientific publications, by the central staff's tours of inspection, or by officers spending some portion of their vacations at research institutes. The case of men of science at present employed under the Department of Education will obviously require careful treatment; such men should not be allowed to join the scientific services as a matter of course, but each case will have to be considered on its merits, and there may still be classes of appointments for which men will have to be recruited independently. Further, the whole question, so far as it affects the employment of officers with scientific qualifications in colleges and universities, will have to be reviewed in connection with the proposals of the Calcutta University Commission regarding recruitment.

In addition to the opinions expressed in the letters received from local Governments, two important conferences of chemists have recently put forward their views on the Commission's proposals. A record of their discussions is appended. A full meeting of the Sectional Conference of Agricultural Chemists at Pusa in February passed the following resolution:—

"That this Conference considers that, in view of the intense local knowledge required for effective work for agricultural improvement by chemical methods, it is not desirable that the chemists in the Agricultural Departments should be formed into a service apart from the ordinary agricultural service,

in which the bond of union would be the science rather than its application. On the other hand, in addition to agricultural chemists attached to the Provincial Departments, this Conference is definitely of opinion that a strong central body of chemists should be maintained by the Imperial Department of Agriculture from whom Provincial Departments could draw for the investigation of special problems."

The main objection taken was, it will be observed, based on the idea that men would usually be transferred after five-year periods. We have explained already that such idea forms no part of the system which we contemplate. It is also significant that the same resolution declared the necessity of a strong central body of chemists for the Department of Agriculture; and, it may be added, the same meeting pointed out the desirability of equipping the agricultural research organisation to deal with certain industrial problems arising out of agricultural research. The sum of these conclusions seems to point to the desirability of supplying some agency which can correlate chemical research with agricultural and industrial problems, and of avoiding the needless expense of creating separate research nuclei for dealing with each separate class of chemical problems.

A conference of chemists was convened in Lahore in January, 1918, by the Indian Munitions Board. It included not only Government officers, but also chemists attached to missionary colleges and employed under private firms. The conference passed no formal resolution, but strongly supported the proposed system of scientific services.

University and Educational Intelligence.

CAMBRIDGE.—As stated in our issue of June 24 (p. 537), a donation of 1000*l.* has been received for the provision of lectures on tropical agriculture for five years. Dr. C. A. Barber has been appointed as lecturer in tropical agriculture.

Dr. F. W. Aston has been elected to a fellowship in Trinity College.

In presenting Sir Joseph Thomson and Sir Joseph Larmor for honorary degrees at Cambridge recently, the Public Orator spoke as follows: "Democritus, philosophus ille antiquus, ut mundum explicaret, atomos finxit, solida rerum primordia, non partium conventu conciliata,

'sed magis æterna pollentia simplicitate.'

Sed, ut discipulus illius ait, difficile est credere in rebus esse quidquam solido corpore, quod demonstravit Professor noster. Atomum enim ipsum ingressus, partes discrevit, ordinavit, legibus subjecit. Immo ut Græcus ex atomo κόσμον eduxit, Anglus in atomum κόσμον introduxit. Et multa quidem ejusmodi investigavit, quæ dicere non concedit Latini sermonis egestas; hoc saltem concedit exponere, quanta universorum lætitia collegio suo Magistrum a Rege impositum nuper viderimus." And: "Adest alter e burgensibus nostris, idem rei physicæ Professor, Isaaci Newton et Georgii Gabrielis Stokes non indignus successor, Societatis Regiæ olim a secretis, qui scientias innumeras provinciam sibi depoposcit et illustravit. Ut carmen quoddam cenaticum discipulorum commemoremus

'æthera materiemque electraque cogitat ille
somnia quæ possint mentes confringere nostras.'

Sed quem mundus ut virum sollertem ingeniosum sapientem miratur, illum collegium suum amicum diligit, providum modestum fidelem. Quem si amplissimis honoribus hodie extollit Academia nostra, hoc multæ et apud nos et apud exteros facere occupaverunt."

EDINBURGH.—Her Majesty the Queen has consented to accept the honorary degree of LL.D. on the occasion of the impending laying of the foundation-stone of the new chemistry department.

GLASGOW.—The degree of D.Sc. was conferred on June 23 on the following:—P. A. Hillhouse, for his thesis "Ship Stability and Trim," with other papers, and D. B. Meek, for his thesis "Cyclonic Storms in the Bay of Bengal for a period of thirty years, from 1886 to 1915 inclusive, with special reference to their Location and Direction of Motion," with other papers.

On the same occasion the following special class prizes were awarded:—Mathematics (Advanced Honours Class): The Cunninghame gold medal to J. M'Kinnell. Natural Philosophy (Ordinary Class): The Cleland gold medal to D. H. Findlay. Political Economy: The Alexander Smart memorial prize to Stewart Mechie. Moral Philosophy (Honours Class): The Edward Caird medal to I. W. Phillips.

On June 24 the degree of LL.D. was conferred on Dr. J. MacIntyre and Sir Robert W. Philip.

LONDON.—At a meeting of the Senate on June 23 Dr. S. Russell Wells was re-elected Vice-Chancellor for the year 1920–21.

Communications were received from the University College Committee and from the Dean of the University College Hospital Medical School, setting forth respectively the terms of the recently published offers made by the Rockefeller Foundation to present (*a*) to the University, on behalf of University College, the sum of 370,000*l.*, and (*b*) to University College Hospital Medical School the sum of 835,000*l.*, for the advancement of medical education and research. Resolutions were adopted expressing the Senate's grateful appreciation of the magnificent generosity shown by the Trustees of the Foundation to the University and to the Medical School of University College Hospital, and accepting the offer made for the benefit of University College.

Mr. A. E. Jolliffe, tutor in mathematics at Corpus Christi College, Oxford, was appointed to the University chair of mathematics tenable at the Royal Holloway College; Dr. B. J. Collingwood (professor of physiology at University College, Dublin) to the University chair of physiology tenable at St. Mary's Hospital Medical School; Prof. L. R. Dicksee to the Sir Ernest Cassel chair of accountancy and business methods tenable at the London School of Economics and Political Science; Mr. H. C. Gutteridge to the Sir Ernest Cassel chair of commercial and industrial law tenable at the London School of Economics and Political Science; Mr. T. E. G. Gregory to the Sir Ernest Cassel readership in commerce, with special reference to foreign trade, tenable at the London School of Economics and Political Science; Mr. D. Knoop to the Sir Ernest Cassel readership in commerce, with special reference to the organisation of industry and trade in the United Kingdom, tenable at the London School of Economics and Political Science; Mr. H. Dalton to the Sir Ernest Cassel readership in commerce, with special reference to tariffs and taxation, tenable at the London School of Economics and Political Science; Mr. Ll. Rodwell Jones to the University lectureship in commerce, with special reference to commercial geography, tenable at the London School of Economics and Political Science; Mr. J. D. Smith to the University lectureship in commerce, with special reference to business organisation, tenable at the London School of Economics and Political Science; and Mr. T. A. Joynt to the University lectureship in commerce, with special reference to transport and shipping, tenable at the London School of Economics and Political Science.

Grants from the Dixon Fund for 1920–21 were

made to Mr. A. S. E. Ackermann, for researches into the physical properties of clay; Mr. J. T. Carter, for researches on the minute structure of the teeth of fossil mammalia; Mr. L. T. Hogben, for researches on the influence of ductless glands; Miss M. A. Murray, for the study of anthropolgy in Egypt; Dr. F. J. North, for preparing illustrations for work in palæontology; Mr. A. K. Wells, for the conduct of a geological survey of part of Merionethshire; and Dr. C. West, for researches on the effect of environment factors on the growth of Helianthus.

The degree of Bachelor of Science in household and social science for internal students is to be instituted.

MR. P. J. HARTOG, Academic Registrar of the University of London, has been appointed Vice-Chancellor of the University of Dacca, Bengal.

DR. R. E. M. WHEELER has been appointed keeper of the department of archæology in the National Museum of Wales, and lecturer in archæology in the University College of South Wales and Monmouthshire.

WITH reference to the recent offer by the Government of a site for the University of London (see NATURE, May 27, p. 404), a largely attended meeting of the council of the University of London Graduates' Association was of the opinion that the "offer of land on the Duke of Bedford's estate, accompanied by an undefined maintenance grant now made by the Government, is in no sense an equivalent for the accommodation as at present guaranteed by the Government, and does not comply with the stipulations laid down by the Senate."

THE following bequests, among others, of the late Dr. Rudolf Messel have recently been published:—5000*l.* to the Royal Institution of Great Britain; 1000*l.* to the Chemical Society; 2000*l.* and his platinum still, "in which I carried out with W. S. Squire my experiments in connection with the decomposition of sulphuric acid," to Mr. Squire, requesting him on his death to leave it to the Society of Chemical Industry; his platinum crucible to the Society of Chemical Industry; and his electric telephone by Reis to the Institution of Electrical Engineers. The residue of the property is to be divided into five parts, four of which are to go to the Royal Society and one to the Society of Chemical Industry, the wish being expressed that the fund shall be kept separate from the funds of the society, the capital to be kept intact, and the whole of the income expended in the furtherance of scientific research and other scientific objects, and that no part thereof shall be applied for charitable objects, as the granting of pensions and the like.

THE first annual conference of the International Federation of University Women will be held at Bedford College, London, on July 12–14. The federation has been formed to promote understanding and fellowship between educated women of different nations, and to unite them into a league to further their common interests and to strengthen the foundations of international sympathy which must form the basis of the League of Nations. The practical means by which the federation seeks to realise its aims are: (1) Organisation of a system of exchange of lecturers and scholars of different universities. (2) Provision of international scholarships and travelling fellowships, particularly the endowment of post-graduate and research scholarships. (3) Establishment of club-rooms and hostels for international hospitality in the various centres of university life. (4) Useful co-operation with the National Bureaux of Education in the various countries. Further information may be obtained from the acting secretary, Miss T. Bosanquet, Universities Bureau of the British Empire, 50 Russell Square, London, W.C.1.

Societies and Academies.

LONDON.

Aristotelian Society, June 7.—Prof. Wildon Carr, vice-president, in the chair.—Rev. A. E. **Davies**: Anselm's problem of truth and existence. The famous proof of the existence of God is not purely ontological, but rather the verification of a specific mode of experience termed "faith." In Anselm's words, it is "faith seeking understanding," and by "faith" is meant a mode of immediate apprehension, awareness of God. Two stages are distinguishable in the reasoning. The first seeks to prove that we must think of ultimate reality in terms of existence. Here the appeal is to logical thought. In the second stage Anselm proves that this ultimate reality is his personal God. Here the appeal is to experience. The argument implies that truth and existence are two ultimate forms of reality: existence is the reality of things, truth the validity of thought-contents. Hence truth must be sought in terms of validity. This is the logical character of the "proof." We can "only *know* as perfectly as possible." We know existent reality only as our thinking is valid, and we cannot think validly that God is non-existent. Between these two ultimate forms of reality is presupposed a fundamental agreement, such that the relations of thought validly represent the real relations of things. For Anselm such agreement has its ground in God. A second implication is that when thinking is valid it starts from existence, in the same sense that its contents are occasioned by existent reality. So that without experience we cannot know. The ethical character of the basic conception of God proves it to be no mere thought-product—that is, knowledge presupposes a mode of reality dissimilar from itself.

Zoological Society, June 15.—Prof. E. W. MacBride, vice-president, in the chair.—Dr. P. Chalmers **Mitchell**: Report on the additions to the society's menagerie during the month of May, 1920.—Prof. J. E. **Duerden**: Exhibition of and remarks upon a series of ostrich eggs.—Miss Joan B. **Proctor**: (1) A collection of tailless batrachians from East Africa made by Mr. A. Loveridge in the years 1914–19. (2) The type-specimen of *Rana Holsti*, Boulenger.—R. I. **Pocock**: The external and cranial characters of the European badger (Meles) and the American badger (Taxidea).—Dr. R. J. **Tillyard**: Life-history of the dragon-fly, with special reference to Australasian forms.

Mineralogical Society, June 15.—Dr. A. E. H. Tutton, past president, in the chair.—F. P. **Mennell**: Rare zinc-copper minerals from the Rhodesian Broken Hill Mine, Northern Rhodesia. Copper minerals, including malachite, chessylite, copper-glance, and undetermined phosphates, are of rare occurrence in the lead-zinc ore of this locality. Still rarer are the copper-zinc minerals aurichalcite and veszelyite; the latter forms minute sky-blue monoclinic crystals ($a:b:c=9{\cdot}71:1:0{\cdot}95$), and differs from the original mineral from Hungary in its colour and in containing little or no arsenic.—Prof. R. **Ohashi**: Note on the plumbiferous barytes from Shibukuro, Prefecture of Akita, Japan. This mineral, which is deposited as a white to brownish-yellow crystalline crust in the fissures and near the orifices of hot springs, is similar to the mineral recently called "hokutolite" from Taiwan (=Formosa); it contains 4·69 to 17·78 per cent. of PbO, and is radio-active.—W. A. **Richardson**: The fibrous gypsum of Nottinghamshire. The relation to the nodular types of gypsum of the fibrous veins of the mineral, which are associated with every other type of gypsum deposit in the district and occur at levels

where there is no other development of the mineral, was considered. Most of these veins are regarded as having been formed shortly after the nodular deposits. The fibres grew upwards and downwards from a plane in the marl, and were probably deposited by descending solutions, being precipitated at planes of tension in a contracting medium. The veins of fibrous calcium carbonate of "beef" described by Dr. Lang show similar structure and field relations, and doubtless originated under similar conditions.—W. A. **Richardson**: A new model rotating-stage petrological microscope. This instrument is intended as a substitute for the larger pre-war models, which at the present time could be manufactured only at very high prices. It is provided with a mechanical stage interchangeable with a plane stage and a conventional substage, and provision is made for rapid change from parallel to convergent polarised light. Owing to the reduction in size, a rotation of 270° only can be provided for the rotating stage.—W. **Barlow**: Models illustrating the atomic arrangement in potassium chloride, ammonium chloride, and tartaric acid. In the case of the chlorides the suggested structure reconciles the X-ray phenomena with the crystalline symmetry. The arrangement proposed for tartaric acid agrees with the graphical formula of the chemists, and the molecular groups have the symmetry and relative dimensions of the crystals.

Royal Meteorological Society, June 16.—Mr. R. H. Hooker, president, in the chair.—W. H. **Dines**: The ether differential radiometer. This instrument has been designed to measure the radiation from the sky after sunset. It consists of two glass test-tubes containing air and a few drops of ether connected by a glass U-shaped tube containing ether to serve as a pressure-gauge. Each test-tube is provided with a movable shield, which protects it from draughts and allows radiation from one direction only to fall upon it. It is used by first directing radiation from the sky upon one of the test-tubes, and then radiation from a "black" body at a known temperature. The known temperature is adjusted until the change has no effect upon the pressure-gauge, and when this is the case it may be assumed that the radiant energy absorbed by the test-tube from the sky is the same as that from the black body, whence the radiation from the sky is found by a table. The equivalent radiation temperature of the sky is often below 0° F., and a method is shown by which in this case the sky radiation can be found without the use of freezing mixtures. This is done by compensating the small radiation from the sky by the excess of radiation from a hot body, so that neutral effect is obtained. The method of calculation and of making up the results is given.—Prof. S. **Chapman** and E. A. **Milne**: The composition, ionisation, and viscosity of the atmosphere at great heights. In the stratosphere, owing to the absence of large-scale mixing, the different constituents of the atmosphere must tend to separate out by diffusion, so that the composition varies with the height: in particular, well-known calculations have shown that, on the usual assumption of the presence of free hydrogen, the atmosphere above 150 km. must consist almost entirely of hydrogen. The authors criticise this assumption; an examination of the evidence renders uncertain the actual existence of this hydrogen atmosphere, and the authors accordingly recalculate the variation of composition with height on the assumption that hydrogen is absent. In this case helium, the next lightest element, is the predominating constituent above 100 km. The results are then used to make an estimate of the depth to which α-, β-, or γ-radiation arriving from an extra-terrestrial source would penetrate the atmosphere. It appears that the range of α-particles would extend down to about 80 km., some 20 km. below the auroral zone. In the case of β- and γ-radiation it is found that the maximum absorption, and consequently the maximum ionisation, should occur at heights of about 50 km. and 25 km. respectively. In each case the region of appreciable ionisation would be confined to a layer of 35 km. thickness, and the unexpected result emerges that the layers would be comparatively sharply defined at their under-surfaces, which practically coincide with the positions of the maxima. These estimates have an interesting bearing on recent theories of the existence of ionised layers in the atmosphere. Lastly, attention is directed to the fact that at great heights, though the coefficient of viscosity is little altered, the density is so small that the effective viscosity is very high, so that any large-scale motion must die down immediately.

Royal Microscopical Society, June 16.—Mr. A. N. Disney, vice-president, in the chair.—L. T. **Hogben**: The problem of synapsis. The data of Mendelian experiment furnish the only critical basis for correlating genetic phenomena and cell-structure, and recent work on the cytoplasmic inclusions (Duesberg, Gatenby, and others) indicates that these elements fulfil none of the conditions which would provide a satisfactory material foundation for alternating, and in many cases biparental, inheritance of any sort. The theory of synapsis postulates the conjugation in the meiotic phase of homologous chromosomes derived from alternate parents preparatory to their segregation in the reduction division, and thus affords an interpretation of gametic purity and allelomorphism. The theory itself rests upon the assumption of the persistent individuality of chromosomes and the definitive organisation of the nuclear reticulum. The study of the meiotic phase raises three questions: (α) Is there an actual conjugation of chromosomes in the prophase? (β) If so, in what manner is it effected? (γ) Do the chromosomes which pair in synapsis separate in the reducing divisions? As regards the first, it is pointed out that the parasynaptic and telosynaptic interpretations for animals are mutually exclusive; the early meiotic phenomena in plants and animals are probably very different. With respect to the second, the question of discovering a mechanism for the interpretation of partial linkage arises. To the last question it is impossible to provide a definite answer from the available data, hence the most valuable evidence on synapsis is inferred from the different sizes and shapes of chromosome pairs in premeiotic mitoses. It is submitted, therefore, that while the cytological phenomena of hybridisation and mutation may yield significant facts, a clear recognition of the relation of the mitotic chromosomes to the organisation of the interkinetic reticulum and a fuller knowledge of the synaptic processes are the most pressing needs for further development of the chromosome hypothesis.—Sir Horace **Darwin** and W. G. **Collins**: A universal microtome. This instrument, which is designed on similar general principles to the Cambridge rocking microtome, cuts sections from objects embedded in paraffin or celloidin or from frozen preparations. It has the advantage over the rocking microtome of cutting flat sections. The plane of the sections is horizontal, which facilitates examination, and the orientating object-holder is of a novel form and easy of adjustment. The rigidity of the frame and object-holder, and the fact that the knife is rigidly clamped at both ends, secures uniformity in the sections. The microtome has no large working surfaces which must be covered with oil, hence irregularities due to varying thickness of the oil-film are eliminated.

The regularity of cutting is unaffected by wear. The rigid connection between hand and object and the smallness of the friction and inertia of the moving parts make for convertience of manipulation. The knife-holder is easily adjusted to give a slicing cut, and can also be moved so that sections can be cut with new parts of the knife as it becomes blunt or damaged. A simple accessory also enables the clearance angle of the knife to be adjusted.

PARIS.

Academy of Sciences, June 14.—M. Henri Deslandres in the chair.—The president announced the death of Prof. Auguste Righi, and gave a short account of his life-work.—A. **Rateau**: Maps of the network of electricity distribution in France. Work of the Technical Committee of the Hydrotechnical Society of France. An account of the work of the society since its establishment in 1912. Its object is the study of all questions relating to the regulation and utilisation of waterfalls. The map, on the scale of 1/200,000, will consist of eighty-four sheets, seventy-eight of which are now submitted to the Academy.—C. **Guichard**: Determination of the congruences C and the congruences 20 which belong to a linear complex.—Ch. Ed. **Guillaume**: The action of metallurgical additions on the anomaly of expansion of the nickel-steels. Certain applications of nickel-steels render necessary the addition of other elements—manganese, carbon, chromium, tungsten, and vanadium. A detailed study of the action of additions of manganese, chromium, and carbon has been made, and the results obtained have been summarised in two diagrams.—J. **Tilho**: The frequency of fogs in the Eastern Sahara. Detailed observations of these dry dust fogs are necessary, especially in the interest of aerial navigation. The results of three years' observations are given, classified as thick, medium, and light, according to the month. The fogs are relatively rare in the months between August and November.—M. Ch. Riquier was elected a correspondant for the section of geometry in succession to the late M. Zeuthen, and M. Pierre Weiss correspondant for the section of general physics in succession to Sir J. J. Thomson, elected foreign associate.—E. **Cartan**: The projective deformation of surfaces.—J. **Andrade**: The special right lines of contact of general helices.—S. **Procopiu**: The double refraction and dichroism of the fumes of ammonium chloride in the electric field. The double refraction and dichroism of ammonium chloride fumes vary with the time and differently. The double refraction varies very nearly inversely as the square of the wave-length, and the dichroism inversely as the third power. If the phenomenon predicted by Voigt exists, it is masked.—MM. **La Rosa** and A. **Sellerio**: A galvano-magnetic effect parallel to the lines of force and normal to the current.—G. **Le Bon**: Certain antagonistic properties of various regions of the spectrum. A screen of zinc sulphide placed behind a trough containing a solution of sulphate of quinine remains unaffected; if a trough of ammoniacal copper sulphate solution is superimposed, the zinc sulphide screen phosphoresces. Similar phenomena were utilised for signalling at night during the war.—J. **Meunier**: The catalytic action of aluminium in the preparation of the chlorobenzenes. Aluminium is superior to the usual catalyst, iodine, in this preparation. A weight of aluminium equal to one-thousandth of the benzene gives the best results. A detailed example of the method is given.—P. **Landrieu**: Researches on the polyacid salts of the monobasic acids: sodium tribenzoate.—R. **Blanchard**: The Durance glacier at Sisteron.—L. **Cayeux**: The iron minerals of the Longwy-Briey basin.—G. **Mangenot**: The chondriome of the Vaucheria. Further experimental evidence, both on the living plant and on fixed stained sections, in support of the views put forward in an earlier communication and adversely criticised by M. Dangeard.—E. **Saillard**: The sugar-beet during the war. The general conclusion is drawn that by using little manure, and especially little nitrogenous manures, the roots are richer in sugar and easier to work. The total production of sugar per hectare is alone affected by this abnormal culture. Similar results have been obtained in Germany.—Ch. **Porcher**: Want of food and the chemical composition of milk. A criticism of the experiments of Lami, together with additional work on the same subject. While accepting the figures of Lami, the author gives them another interpretation, and considers that the variations of chemical composition observed are due to the retention of milk and not to starvation.—P. **Mathias**: The structure of the lips of fishes of the genus Chondrostoma (family Cyprinidæ).—M. **Piettre** and A. **Vila**: The separation of the proteins of the serum. The technique proposed differs considerably from the classical methods studied by Hofmeister, Starke, Michailoff, and J. Kauder, as large quantities of mineral salts are not used. The serum is exactly neutralised, precipitated by acetone, and the albuminoids extracted with water, the last washings being saturated with carbon dioxide. The insoluble proteins free from albumin are left as a grevish-white precipitate.—G. **Bertrand** and Mme. **Rosenblatt**: The action of chloropicrin upon some bacterial fermentations. Details of experiments on the action of chloropicrin at different concentrations on the lactic ferment, the ammoniacal ferment, and the sorbose bacterium. Chloropicrin was found to exert a strongly toxic action upon all living cells, and is comparable, in some cases, with the most powerful known disinfectants.—A. **Frouin**: Variations in the fatty matters of the tubercle bacillus cultivated on definite media in the presence of earths of the cerium group.—F. **Ladreyt**: Trophic superactivity: giant cell and cancer.—MM. **Fauré-Fremiet**, **Guieysse**, **Magne**, and A. **Mayer**: Cutaneous lesions determined by certain vesicant compounds.

Books Received.

Chemical Theory and Calculations. By Prof. F. J. Wilson and Prof. I. M. Heilbron. Second edition. Pp. vii+144. (London: Constable and Co., Ltd.) 4*s*. 6*d*. net.

The Elements of Electro-Technics. By A. P. Young. Pp. viii+348. (London: Sir Isaac Pitman and Sons, Ltd.) 7*s*. 6*d*. net.

Historical Geography of Britain and the British Empire. In two books. Book i.: The Making of England: The Making of Empire: The Establishment of Empire, B.C. 55 to A.D. 1815. By T. Franklin. Pp. viii+216. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd.) 2*s*. net.

Space, Time, and Deity. By Prof. S. Alexander. 2 vols. Vol. i., pp. xvi+347; vol. ii., pp. xiii+437. (London: Macmillan and Co., Ltd.) 36*s*. net.

Education for Self-Realisation and Social Service. By F. Watts. Pp. xii+275. (London: University of London Press, Ltd.) 7*s*. 6*d*. net.

The Child Welfare Movement. By Dr. Janet E. Lane-Claypon. Pp. xi+341. (London: G. Bell and Sons, Ltd.) 7*s*. net.

A Summer Tour (1919) through the Textile Districts of Canada and the United States. By Prof. A. F. Barker. Pp. xi+197. (Leeds: Printed by Jowett and Sowry, Ltd.).

The Cambridge British Flora. By Prof. C. E. Moss. Assisted by specialists in certain genera. Vol. iii. Pp. xvi+200; plates, pp. vi+191. (Cambridge: At the University Press.) Two parts. 6*l.* 15*s.* net; 2 parts in 1 vol., 7*l.* net.

Memoirs of the Geological Survey. The Geology of Anglesey. Vol. i. Pp. xl+388+xxvi plates. Vol. ii. Pp. 389–980+plates xxvi B–lx+folding plates. By E. Greenly. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd.) 2 vols., 3*l.* 3*s.* net.

The Arithmetic of the Decimal System. By Dr. J. Cusack. Pp. xvi+492. With Answers. (London: Macmillan and Co., Ltd.) 6*s.*

Medical Research Council and Department of Scientific and Industrial Research. Reports of the Industrial Fatigue Research Board. No. 7: Individual Differences in Output in the Cotton Industry. (Textile Series, No. 1.) Pp. iii+13. (London: H.M. Stationery Office.) 6*d.* net.

Les Révélations du Dessin et de la Photographie à la Guerre: Principes de Métrographie. By Lt.-Col. Andrieu. Pp. xiii+112. (Paris: Gauthier-Villars et Cie.) 8 francs.

Elements of Radio-telegraphy. By Lieut. E. W. Stone. Pp. vii+267+xxxiii plates. (London: Crosby Lockwood and Son.) 16*s.* 6*d.* net.

Grasses and Rushes, and How to Identify Them. By J. H. Crabtree. Pp. 64. (London: The Epworth Press.) 1*s.* 9*d.* net.

Space, Time, and Gravitation: An Outline of the General Relativity Theory. By Prof. A. S. Eddington. Pp. vii+218. (Cambridge: At the University Press.) 15*s.* net.

Pasteur: The History of a Mind. By Prof. E. Duclaux. Translated by E. F. Smith and F. Hedges. Pp. xxxii+363. (Philadelphia and London: W. B. Saunders Co.) 21*s.* net.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. xxiii. No. 1, 1920. Pp. xii+644+xxx plates. (London: Institute of Metals.) 31*s.* 6*d.* net.

A History of English Philosophy. By Prof. W. R. Sorley. Pp. xvi+380. (Cambridge: At the University Press.) 20*s.* net.

The Mystery of Life as Interpreted by Science. By R. D. Taylor. Pp. 176. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd.) 3*s.* 6*d.* net.

Applied Eugenics. By P. Popenoe and Prof. R. H. Johnson. (Social Science Text-Books.) Pp. xii+459. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 14*s.* net.

Air Ministry. Meteorological Office, London. Professional Notes, No. 8. Temperatures and Humidities in the Upper Air: Conditions Favourable for Thunderstorm Development, and Temperatures over Land and Sea. By Capt. C. K. M. Douglas. Pp. 110–139. (London: Meteorological Office, Air Ministry.) 2*s.* net.

Air Ministry. Meteorological Office. Geophysical Memoirs, No. 16. Aids to Forecasting: Types of Pressure Distribution. With notes and tables for the fourteen years 1905–18. By E. Gold. Pp. 147–74. (London: Meteorological Office, Air Ministry.) 2*s.* 6*d.* net.

Notes on Chemical Research: An Account of Certain Conditions which Apply to Original Investigation. By W. P. Dreaper. (Text-Books of Chemical Research and Engineering.) Second edition. Pp. xv+195. (London: J. and A. Churchill.) 7*s.* 6*d.* net.

The Concept of Nature. By Prof. A. N. Whitehead. (Tarner Lectures delivered in Trinity College, November, 1919.) Pp. ix+202. (Cambridge: At the University Press.) 14*s.* net.

William Smith: His Maps and Memoirs. By T. Sheppard. Pp. iii+75–253+plates. (Hull: A. Brown and Sons, Ltd.)

Imperial Institute. Indian Trade Inquiry. Reports on Oil-Seeds. Pp. ix+149. (London: J. Murray.) 6*s.* net.

Conifers and their Characteristics. By C. Coltman-Rogers. Pp. xiii+333. (London: J. Murray.) 21*s.* net.

The Small Farm and its Management. By Prof. J. Long. Second edition. Pp. 328. (London: J. Murray.) 7*s.* 6*d.* net.

Anniversaries and other Poems. By L. Huxley. Pp. x+82. (London: J. Murray.) 5*s.* net.

Diary of Societies.

MONDAY, JULY 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ARISTOTELIAN SOCIETY (at 74 Grosvenor Street), at 8.—Rev. Dr. W. F. Geikie Cobb: Mysticism, True and False.

WEDNESDAY, JULY 7.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (in Canada Building, Crystal Palace), at 6.—E. H. Cunningham Craig: Wild Catting (Free Illustrated Lecture).

SATURDAY, JULY 10.

PHYSIOLOGICAL SOCIETY (at Physiological Laboratory, University, Oxford), at 4.—J. B. Leathes and H. C. Broadhurst: Excretion of Phosphate.—J. Barcroft and F. J. Roughton: Diffusion Co-efficient of Lung.—S. P. L. Sörensen and E. J. Cohn: Solubility of Globulin.—A. Krogh: Reaction of Blood Vessels to Local Stimuli.

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